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1943

Experimental study of instruction and age differences  
in the psychological function of speech.





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THESIS

An Experimental Study of  
Instruction and Age Differences  
in the  
Psychological Function of Search

submitted by

Harriette Bowers Ankeny

( Bachelor of Arts, Pennsylvania College for Women, 1923 )

in partial fulfillment of requirements for the degree of  
Master of Education

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Deep appreciation is expressed to Dr. Herbert Blair, Professor of Statistics, for his helpful suggestions in the statistical treatment of the study.

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**Search ; an Intermediate between Perception and Thinking.**

### The Search Task or Problem.

Chapter I Introduction

The Place of Search in the Field of Psychology.

Search : an Intermediate between Perception and

Thinking.

The Nature and Definition of Search.

The Search Task or Problem.

Previous Research Studies on Search.



# An Experimental Study of Instruction and Age Differences in the Psychological Function of Search.

## Introduction

The following experimental study is an attempt to investigate age differences and the relative effectiveness of two forms of instruction in search. By search is meant "hunting-to-discover" a designated object in an arrangement of many. This arrangement of many small objects we shall call the "search field." This experiment employs two search fields to be known as Box I and Box II. Search Time is the time required to discover the designated object. In order to secure data on age differences, subjects of two age groups were employed; namely, a group of children in the third grade of school, and a group of adults. To secure comparable data, the same experimental procedures were used for both groups.

Two ways of informing each child or adult what he is to search for were used. The two ways of designating the search object are the two forms of instruction studied. In one, the object that is to be searched for is shown to the subject. This is called the "visual" method of instruction. In the other form of instruction, the subject is told what

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he is to find in the search field. This is called the "verbal" method of instruction.

Each subject is required to find an object designated by name (verbal instruction) in one of the two search fields, and in the other search field, he is required to find an object which is exactly the same as one shown to him by the experimenter (visual instruction). The data are analyzed for differences in the search times as between children and adults, and also for differences related to the two forms of instruction.

### The Place of Search in the Field of Psychology

Bentley writes, "Every day living is an art; but it is an art which requires in thoughtful men and women an orderly understanding of the functional and governmental facts which are to be found in the sciences of life."<sup>1</sup>

Different schools of psychology have defined and advanced psychology according to their theories along various specific phases of the science. In general, however, it can be said that modern psychology deals

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1 Bentley, Madison. The New Field of Psychology, p.351.

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with the activities of the individual.<sup>1</sup> As expressed by  
Kingsley,<sup>2</sup>

"Psychology is conceived as the scientific study of the activities of the individual. It is concerned with all the activities of an individual in which he reacts to and makes adjustments to his physical and social environment."

The word activities encompasses all the performances engaged in by the individual in relationship to his environment. Certainly these performances are many and varied. They include what we do with our arms, legs, and feet when we swim, walk, or run. They include apprehending the on-coming train, observing the newly erected bulletin board, comprehending the newly assigned lesson, rejoicing over the victory of the golf match, or feeling depressed by the saddening news. These activities which make up the field studied by the psychologist include all the diversified performances in which individuals engage as a means of getting on in their environment.

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1 Woodworth, Robert S. Psychology, Fourth Edition. p.3

2. Kingsley, Howard L. "Nature and Conditions of Learning" Manuscript- p.10.

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1 Woodworth, Robert S. Psychology. Fourth Edition. p. 2.

2. Kingsley, Howard L. "Nature and Conditions of Learning"

Manuscript - p. 50.



Some units of activity are simple. Some are complex. Some of the smaller or simpler units are integral parts of larger and more complex units of performance. The term "function" is used to refer to any unit of activity simple or complex which we may select for observation, discussion, or study.

As these activities of the individual in his every day life are the materials to be dealt with by the psychologist it has been necessary to sort and to classify them. The activity of listening to a lecture is, when regarded as a single performance, a psychological function. If we consider playing a game of golf as a unit of behavior it may in its entirety be regarded as a psychological function. Or we can select any part of the performance as a unit for consideration. For example, the act of taking a golf club from the golf bag is a part of the total performance of playing a game of golf. But this, too, is a function of the psychological organism when singled out for consideration.

In this systematizing of human activity, psychologists have found similarities and differences which serve as a basis for classification of the multiplicate functions. First, there are observations which are made directly through the various sense organs. We hear the siren, see the burning building, notice the vivid gold of the

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setting sun, feel the satin smoothness of the polished marble, taste the sweet or sour of some foods, or realize from the sound of the music that a band is passing in the street. This form of activity in which we become aware of the present surroundings or events is called perception. Also, man can call to mind past happenings, past impressions, past observations. This is remembering, and memory is the term that stands for functions of this type.

Also, we look toward the future, plan, make suppositions and form opinions. This activity is known as imagination. Then there is motor activity such as speaking to a friend, walking across the park, or sawing logs for the fireplace. These activities involving movements are of the executive nature and are called actions. Those activities brought into play by helplessness, awkwardness, and inability to make an appropriate response to the situation encountered and characterized by feelings of fear, anger, or untold joy, are the emotions.

These mentioned functions of perception, memory, imagination, action, and emotions, do not always take place separately, but in many cases blend and combine. They are organic performances and each is dependent more or less upon the antecedent functions. The individual must perceive before he can remember episodes of the past. Perceptions evolve from action. Emotions depend upon perceptions,



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and imagination is governed by the experiences of the past. Then there are off-shooting branches and extensions to be considered. Perception is accompanied and enlarged by inspection. Inspection is characterized by close examination and critical observation with intent to discover more fully. Search, the function with which this study is<sup>1</sup> concerned, extends beyond inspection. As Kingsley describes it :

"Here we have an active quest, an anticipatory exploration which is initiated and sustained by a desire or need to discover a particular object or in some cases a goal."

As the individual searches for an object there is anticipation, and hence a blending of imagination and inspection. Beyond inspective and perceptive search in the list of psychological functions comes the function of comprehending. It is the process of building up topical meanings. Through it we acquire understanding. In it are combined several of the above mentioned functions.

" Next and finally we have 'elaborative thinking' through which we figure out

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1. Kingsley, Howard L. "Nature and Conditions of Learning"  
Manuscript. p.15.

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or create new knowledge, convictions, or solutions to problems by employing in appropriate ways and toward a definite end the functions of perception, memory, imagination, action, inspection, search, and comprehension in what is regarded as the highest and most distinctive feature of the adaptive processes of man.<sup>1</sup>"

### Search; an Intermediate between Perception and Thinking.

In searching, the organism looks forward into and toward the future, and anticipates; it inspects the search field; its inspection and final discovery of the search object employs perception. In search there is more than preparation for discovery, more than anticipation of the object sought for. In this function the organism actively explores with the purpose of discovery. This seeking out under the impelling influence of a need or desire for discovery is the characteristic of search which distinguishes it from perception.

Search and Thinking are similar in that both are problem-solving. They are prompted and maintained by a

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1. Kingsley, Howard L. "Nature and Conditions of Learning".

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J. Kingsley, Howard J. "States and Conditions of Learning."



situation and they both move toward a goal which satisfies a demand made upon the organism by the situation. They extend beyond perception. However, as search and perception are in some respects like, and still unlike in that search involves more than perception; so we find search and thinking alike to some extent, but unlike in that thinking goes beyond search by its employment of symbolic materials. Therefore, we find search occupying a place intermediate between perception and problem-solving thinking. " If search does not give us perfect continuity of psychological operation, it does point to a real intermediary that relates perception and thinking in a functional way."<sup>1</sup>

#### The Nature and Definition of Search.

The writer defines "search" as an activity of purposeful, systematic, exploratory investigation, prompted and maintained by a lack, need, or demand. It is surprising that an activity which occupies so important a place in human living has received so little attention and study by psychologists. It is mentioned sporadically in the literature, but few systematic studies have been made of it.

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1. Kingsley, Howard L. Search; A Function Intermediate between Perception and Thinking. p.53

Of. Psychological Monographs, No. 2 Volume XXXV.







Text books rarely mention it, much less define it systematically. Kingsley<sup>1</sup> who has probably done more experimentation in the field of search than any other psychologist describes search as :

"An active quest, an anticipatory exploration which is initiated and sustained by a desire or need to discover."

Bentley's<sup>2</sup> writings urge attention to this function of search in the following graphic presentation :

"In the functions considered at large, the dynamic aspect of search is fundamental. At the first beginnings of psychological performance in the infant we find this quality of pushing-ahead and reaching-out in the form of primitive search."

Search does not end with infancy. Analyze the school programme of any nation of the world that offers formal education. There is probably no subject nor topic taught which does not involve search in some way. How can the

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1. Kingsley, Howard L. "Nature and Conditions of Learning".

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2. Bentley, Madison. The New Field of Psychology. pp.329-330.

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J. Kingsey, Howard L. "Nature and Conditions of Learning."

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 S. Bentley, Madison. The New Field of Psychology, pp. 222-230.  
 p. 12



child learn his lessons without searching into the subject matter, or searching for answers in the additions and subtractions, or just looking for his mislaid book ? The solving of problems calls for search for clues.

Let it be noted that in the form L of the New Revised Stanford-Binet <sup>1</sup> "Tests of Intelligence" a normal thirteen year old child is expected to be able, as a result of instruction, to plan an hypothetical search so as to retrieve his purse containing much money which has been lost in a very large field.

Not only does formal education involve search, but it encourages search. Is not search a component part of the educative process, an essential to learning ? What is research but a systematic search for truth ?

So as to cover all the World's peoples and include those who have not undergone formal education, is it not necessary for them to search for many things under the prompting of needs? Primitive man searched for food because his stomach was hungry. He searched for shelter and warmth. Nor do the senile get on without employing the function of search. The aged gentleman who misplaces his eyeglasses either goes through the activity of search or causes another to search for him.

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1. Terman, Lewis M. and Merrill, Maud A., Measuring Intelligence. p.113

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It is not enough to include in our discussion only the human individuals who indulge in active search. Let us note that the jungle animal needs to hunt its prey. The birds migrate and seek for a new home. All through the animal kingdom is found search.

Madison Bentley, who has pioneered the field of search, has identified and placed it in the scheme of psychological functions, traced it through the daily pattern of life, and graphically describes its characteristics and activities. He says:

"All of our psychological operations make their first appearance after birth and all pass through important changes throughout life. A convenient way of relating them, therefore, is through some temporal or developmental plan. We find the primordial function to be a searching and impulsive kind. This is primitive search. It appears soon after birth and is directly followed by perception-action, a mode which involves neither a separate apprehension of objects nor a prophetic and independent action, but both together."

It is not enough to include in our discussion only the human individual who indulges in active search. Let us note that the jungle animal needs to hunt its prey. The birds migrate and seek for a new home. All through the animal kingdom is found search.

Madison Bastley, who has pioneered the field of search, has identified and placed it in the scheme of psychological functions, traced it through the daily patterns of life, and graphically described its characteristics and activities. He says:

"All of our psychological operations make their first appearance after birth and all pass through important changes throughout life. A convenient way of relating them, therefore, is through some temporal or developmental plan. We find the primordial function to be a searching and explorative kind. This is primitive search. It appears soon after birth and is directly followed by perception-action, a mode which involves neither a separate apprehension of objects nor a precise and independent action, but both together."

J. Madison Bastley, The New Field of Psychology, p. 364



Of this primitive search which is so interwoven into our lives, Bentley<sup>1</sup> says :

"On the psychological side, appropriately appears the fundamental aptitude of 'search', a mode which is obviously displayed in the human infant soon after birth, and which naturally exemplifies the energetic and directive course of living. When later this 'primitive search' is combined with the digestive sequence of feeding, assimilation, and removal of waste, and still later with perceiving and the simpler forms of action, there concordantly appear the more elementary operations of desiring, longing, anticipating, and attaining. Thereafter and throughout life, the derived and complicated forms of searching play a large part in the psychological economy of the child, the youth, and the adult."

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1. Bentley, Madison. The New Field of Psychology. pp.20-21.

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1

Diagram I taken from Bentley<sup>1</sup> shows that author's conception of the primordial nature of "primitive search". It shows primitive search to be the earliest function which appears in the infant. The other functions all emerge from it. The first functions to evolve from primitive search are perception and action. From perception are differentiated a little later the functions of memory and imagination, and emotion is derived from action. Goal searching continues through life to be an important and central form of activity. Inspection is derived from goal searching and perception. Comprehension emerges from combinations of goal searching with perception, memory, imagination, and inspection. Elaborative thinking, the apex of man's mental activity issues from the combined operation of all of the other functions.

The more advanced stages of goal searching demand an alertness and a 'noting more in detail'. This searching activity then includes inspection of the search field. With and because of inspection and search comes understanding. The process of searching for understanding often turns up problems which cannot be solved by perceptual discovery but which must be thought out. This search may itself involve elaborative thinking.

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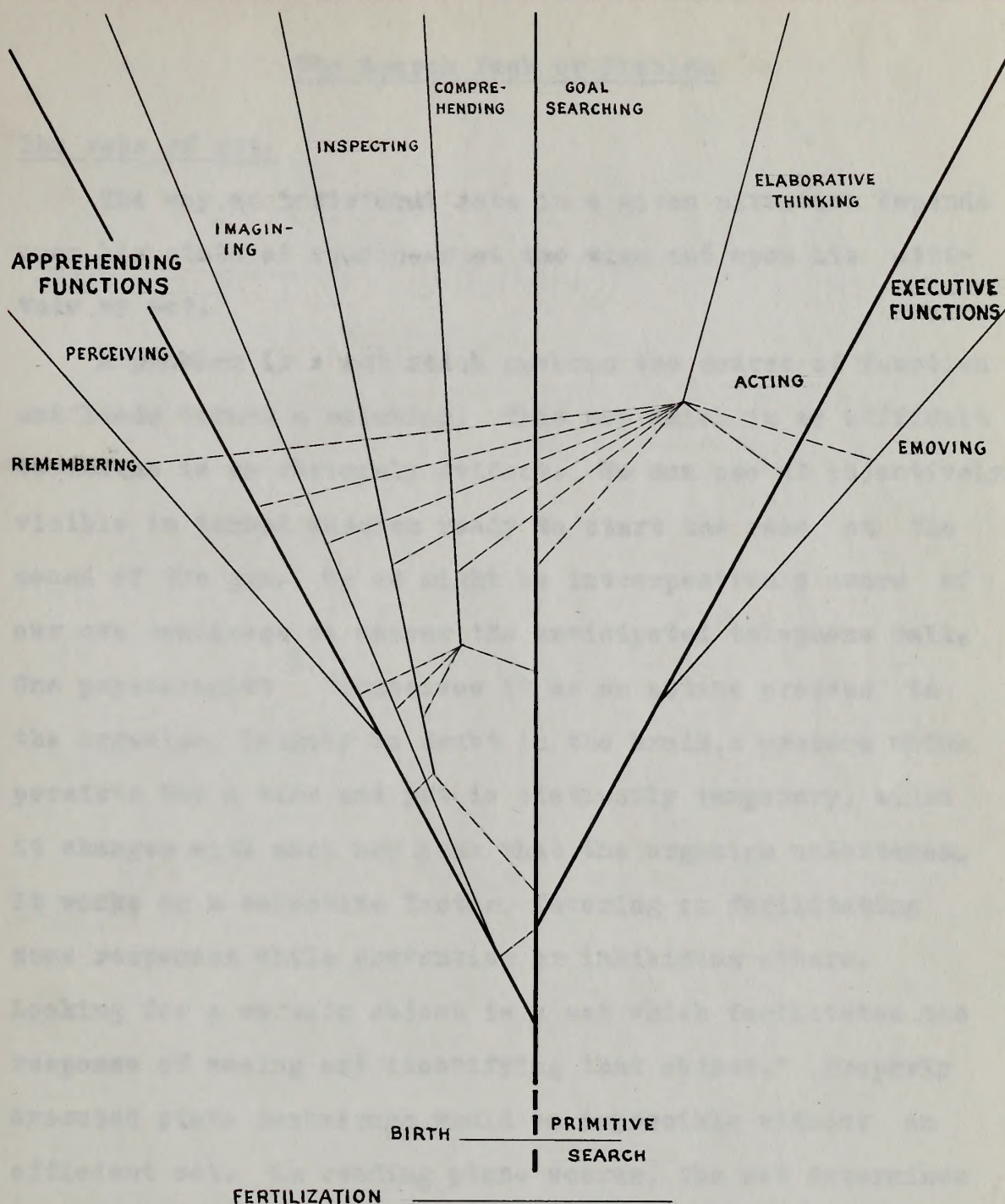
1. Bentley, Madison, "The Psychological's Uses of Neurology", The American Journal of Psychology, Vol. XLIX, (April, 1937), p. 236.



Diagram 1, taken from Piaget, shows that an infant's conception of the primitive nature of "primitive search". It shows primitive search to be the earliest function which appears in the infant. The other functions all emerge from it. The first functions to evolve from primitive search are perception and action. From perception are derived: stated a little later the functions of memory and imagination, and action is derived from action. Goal searching continues through life to be an important and central form of activity. Imagination is derived from goal searching and perception. Cooperation emerges from combinations of goal searching with perception, memory, imagination, and inspection. Elaborative thinking, the apex of man's mental activity issues from the combined operation of all of the other functions.

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### THE PRIMARY PSYCHOLOGICAL FUNCTIONS

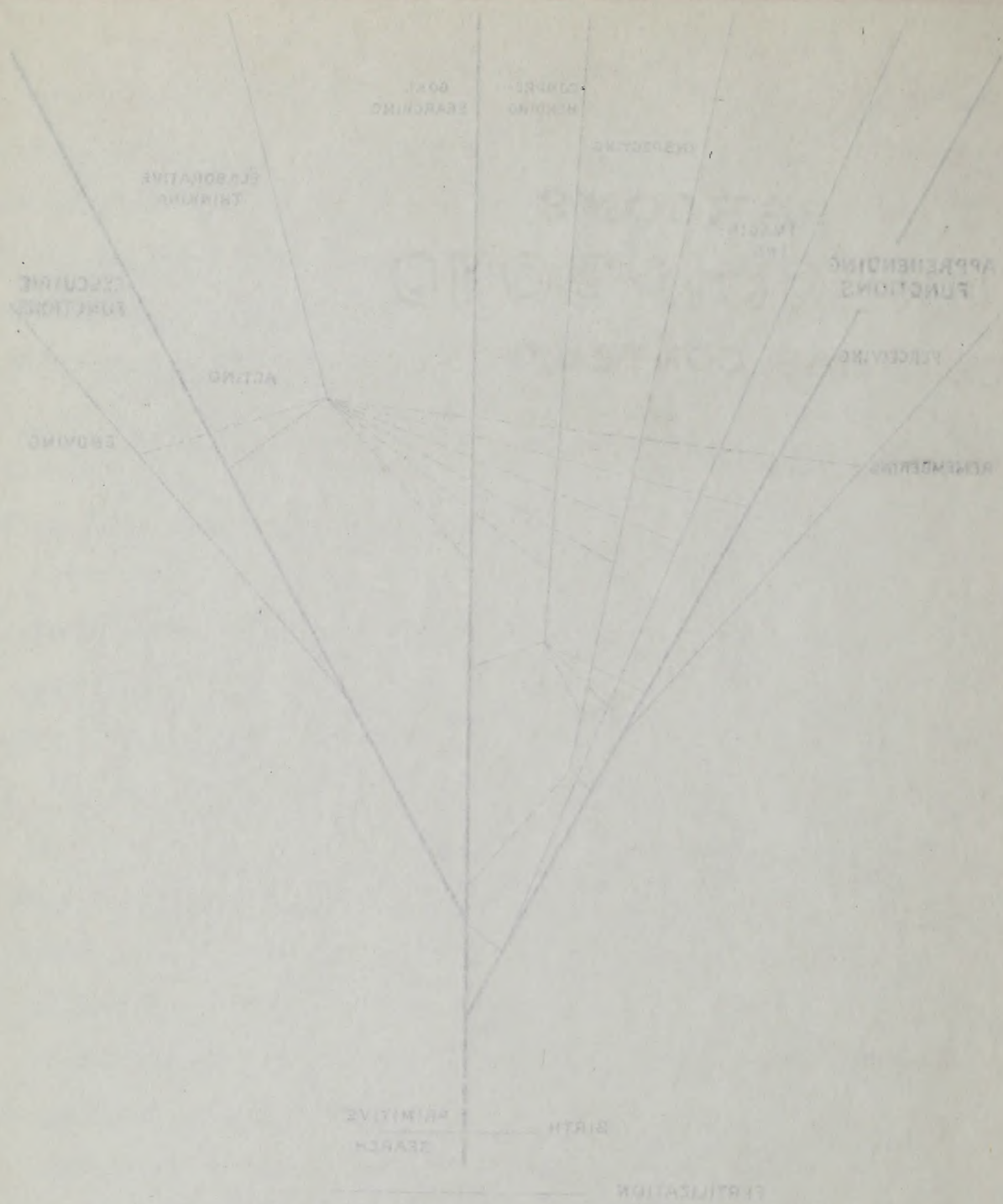
#### DIAGRAM I

( From Bentley <sup>1</sup> )

1. Bentley, Madison, "The Psychologist's Uses of Neurology", The American Journal of Psychology, XLIX, (April, 1937), p. 236.

J. Bentley, Madison, "The Psychologist's Use of Psychology,"  
 The American Journal of Psychology, XLIX (April, 1937), p. 282.

# THE PRIMARY PSYCHOLOGICAL FUNCTIONS





## The Search Task or Problem

### The role of set.

The way an individual acts in a given situation depends upon his state of readiness at the time and upon his attitude or set.

A problem is a set which governs the course of function and leads toward a solution. This set which is so difficult to define is so obviously evident. We can see it objectively visible in tensed muscles ready to start the race at the sound of the gun. Or we might be introspectively aware of our own readiness to answer the anticipated telephone call. One psychologist<sup>1</sup> "conceives it as an active process in the organism, largely no doubt in the brain, a process which persists for a time and yet is distinctly temporary, since it changes with each new task that the organism undertakes. It works as a selective factor, favoring or facilitating some responses while preventing or inhibiting others. Looking for a certain object is a set which facilitates the response of seeing and identifying that object." Properly executed piano techniques would be impossible without an efficient set. In reading piano scores, the set determines the response made to the context or passages. There are

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1. Woodworth, Robert S. Psychology, Fourth Edition  
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Looking for a certain object is a set which facilitates the response of seeing and identifying that object. Properly executed piano techniques would be impossible without an efficient set. In reading piano notes, the set determines the response made to the context or passages. There are



certain factors which govern activity. There are the external factors which constitute the stimulus situation to which the individual reacts, and there are the internal factors which are within the individual. One's activity depends both upon factors within the individual and the outside situation confronting him. Or we might say that the environment acts upon the organism. What we perceive is dependent upon what is presented to and transmitted through our sense organs. A pleasant memory is aroused by the sight of a picture of the Hakone Mountain Range. The child's toys and games promote an activity of learning. Any form of the teacher's instruction is an external factor to the child. Explanations help determine the comprehension. It is imperative that these external factors be properly suited for the arousal and direction of appropriate responses to attain the desired development.

While we must be mindful that the external factors have an important influence on one's reactions it is also to be remembered that different persons react differently to the same situation. The individual responds to something external but his response is determined largely by factors within him. In man are found governing sets which determine the nature, and path of activity in a given situation. These sets are

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forms of readiness for activity and include determining tendencies for the nature of responses.

### Various forms of set.

Hunger and Thirst, caused by a need for food and drink, motivate activity of hunting for food and entering into the process of eating. Yet the most delectable foods are disregarded in the absence of hunger. Hunger causes us to respond to food by eating, because the hungry person is in a state of readiness or is set for reacting in this way to situations which will satisfy his need for food. Likewise many forms of activity are entered into because of other biological sets, such as need for sleep when tired, for exercise when rested, or for escape from pain.

Some sets are acquired. They develop during one's life and become habit tendencies and other functional trends. They may have been built up by repetitions and become a part of one's make up. We skate on the ice with ice skates and we skate on the wooden rink with roller skates--not because of the dictates of these objects, but because of our own acquired predispositions to react to these objects in these ways. What we perceive as we look upon these objects depends on the perceptual trends which have resulted from past functioning. The meanings we attach to the thoughts spoken by another, the memory

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recalled by the sight of some object, the nature of the emotional upset caused by disagreeable circumstances, are all the result of functional trends formed by previous activity. The individual's reaction to a learning situation as presented by another, depends upon habit tendencies and other functional inclinations which have developed all through the individual's life time. All individuals can not react alike to the same instruction because of differences in their previous experiences.

Even a very young child develops social motives . They are sets which influence his behavior. He wants approval by others, therefore, he tries hard to out-do his contemporaries in order to feel his display of superiority.

Attitude is also a form of set which affects an individual's reactions to instruction. It is a set which<sup>1</sup> an individual brings to a learning situation. Woodworth defines attitude as a set or disposition ( readiness, inclination, tendency ) to act toward an object. A child's attitude may be dislike for some one or some thing.

Interest is an attitude which is necessary for expert accomplishment.

Attitude and intelligence should not be confused. A bright child can become bored, lose interest, and the teacher may consider him dull. Even in this period of

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1. Woodworth, Robert S. Psychology, Fourth Edition. p.392.

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boredom, the child might enter into an intelligence testing programme with poor spirit and show a low I.Q. Thus it could be his poor attitude which kept him from his best efforts. On the other hand let us consider the child who does something worthy and is given outstanding attention and applause by his teacher and classmates. He secures recognition. He is spirited and his attitude is good. A good attitude is set which results in good outcome.

Besides these relatively permanent sets which have resulted from past functioning there are task and problem. Task is concerned with the action, problem with thinking. They are not independent of the past, yet they must be formulated to provide a form of activity at the time suitable to the requirements of the moment. Their service is comparatively temporary because the task set disappears at exactly the second that the task is completed. The problem no longer exists after it has been worked out or solved.

The task arises from the need for action. It involves an idea of the end that is to be accomplished with active intention to carry out the indicated action. It is an intent to do something which initiates and directs the course of the action.

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Dewey describes 'Problem' as a felt difficulty. It



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is not the precarious situation itself, nor the interrogating words of a teacher -but it is the mental and bodily state induced by these. It is a set, and this set initiates and governs the search for solution.

### Sources of the Task

Let us consider three sources from which task is derived. First there is the demand of the situation or occasion. For example, because extremely hot weather has prematurely set in ; the rise in temperature demands that I hunt out of my wardrobe a lighter weight top coat. Upon locating the thinner coat a sense of satisfaction takes the place of the former need.

The second source from which task arises is instruction coming from another. An example is seen in the case of a child who is told to go to the store by the mother. We must recognize here that the task is not the request of the mother, nor the demands of going to the store, but the child's own governing task set which results from these. The child's task for going to the store is derived from the request made by the mother.

The third source from which the task arises is one's self. To illustrate, the history student does an extra assignment not made by the teacher. It is done not because of any outside influence but because of his own impulse, interest, need, or wish. So the task and the problem set



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In this present experiment the task is derived from instruction given by the experimenter. The experimenter instructs the subject to find a designated object. The instruction serves to arouse in the subject the search-task which initiates and directs the course of the exploratory activity and sustains it until the goal is reached. There are two types of instruction employed by the experimenter. One is the visual instruction where the subject is shown exactly what he is expected to find. Here the concept of the search object is established by visual perception of that object. The subject looks upon the object he is to find before he starts hunting for it. The other type of instruction is verbal. In this case, the search object is merely named, and it is necessary that the subject establish his concept of what he is to search for from hearing the spoken word. What he looks for then will depend upon the meaning which the word has for him at the moment. This will depend upon associations which he has made with the word prior to the experiment. It appears that the chances for an inappropriate concept or image of the search object would be greater where the subject receives only the name of the object than where he sees it first. In the latter case he should know exactly what to look for. With verbal instruction the



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object which the subject has in mind as the goal of his search may differ from the object which he must actually perceive and recognize as his goal. Previous studies on search have indicated that when the subject's concept of the object deviated from the one he was to find, discovery and recognition were retarded. Visual instruction was found to give the subject a more precise and accurate picture of his goal-object and this made for more immediate recognition of that object when the searcher's eyes fell on it. Where there was a discrepancy between the concept carried during the search and the perception of the search object the subject sometimes failed to realize that the object perceived was actually the one he was supposed to find. Since such discrepancy is more likely to occur with verbal instruction and since it may be expected to result in longer search times this study has undertaken to compare the relative effectiveness of these two forms of instruction in terms of their search times. Will we get a difference for the two forms of instruction in the time required for finding the designated object? Will there be the same difference for adults as for children? If a difference is found it may be concluded that the one which yields the shorter search times is the better means for preparing the subject for an efficient search and that is so because it provides the subject with a more adequate search-task or set.

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### Previous Research Studies on Search.

'Search' is placed in the pattern of psychological functions by Madison Bentley who shows the arrangement as:

"First, the apprehending group  
(perceiving, remembering, and imagining);  
secondly, the executive group ( acting  
and emoving), and beyond these inspecting,  
comprehending, goal-searching and  
elaborative thinking."

An experimental study was carried out by Kingsley entitled "Search ; A Function Intermediate between Perception and Thinking". This experimentation started on the premise that observations would show the fundamental differences between thinking and perception. The problem was to explore by a suitable method those two types of functional operation for the purpose of discovering their similarities, differences, and to determine whether there could be found intermediate modes of operation serving to fill the gap between them. The set up of the carefully controlled experiment called into action three types of functional operation, i.e., perception, search, and thinking. Results showed that search was a type of performance resembling in some ways both perception and

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1. Bentley, Madison, "The Psychologist's Uses of Neurology",  
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Previous Research Studies on Gestalt

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thinking but possessing characteristics of its own. The results of the investigation were as follows:

" 1. Search is, like perception and thinking, a function or operation of the total organism. Standing midway between these two it serves to connect and to relate them.

2. The mental items employed in search are of the same kind, as those used in perception and thinking. There is here, then, no novel or unique mental "element" or mental constellation.

3. Search may include perception, but it also includes something more. While in simple perception the organism is engaged in apprehending present objects or on-going events, in search it is actively and attentively endeavoring, by way of anticipatory exploration, to discover a specified object or a defined end. In "perceptive search" this discovery is made by way of perception.

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thinking; but here it is only a part of the entire operation. Thinking "elaborates" by the use of its symbolical meanings which are derived through search. This form of search is the "elaborative" form.

5. The intermediate relationship of search to perception and to thinking is further attested by the fact that thinking may be resolved under repetition into search, and search likewise may be resolved into perception- very much as choice under repetition drops to the impulsive forms and impulse<sup>1</sup> in turn to automatic action."

Another experimental study on search was conducted by Kingsley. This problem set up was to discover the natural relations which the functions of perception, thinking, and that exploratory type of performance called 'search' sustain to each other. The purpose of this study was to get more complete observations upon the process of exploration in order to obtain a more adequate description

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1. Kingsley, Howard L. Search; an Intermediate between Perception and Thinking. Psychological Monographs, XXXV, No.2, 1926. p.55.

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of this type of function than had been accomplished by the earlier study. The procedure involved the showing of pictures where-by the subjects entered into a search performance to discover and identify the named object in the picture. Observations made by the subjects on their visual explorations were fully recorded. These reports revealed as features of the search performances : exploratory eye-movements, rapid shifts of attention, verbal kinaesthesia, and muscle strains of head, eyes and neck. The termination of search came with discovery of the object and was accompanied by satisfaction and relaxation.

<sup>1</sup>  
A later study by Kingsley was published under the title "The Influence of Instruction and Context upon Perceptive Search." This experiment compared the two forms of instruction, visual and verbal, which are employed in the present investigation. It was found in that study that frequently the object-meaning derived by the subject from verbal instruction, where the search object was simply named, did not coincide with the perceived object. This delayed and hindered discovery and termination of the search. This experiment was arranged so that under "visual instruction", the subject was instructed as to what he was to hunt for by being shown an exact duplicate of the search object.

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an exact duplicate of the search object.



The results revealed that search and apprehension follow the same general course whether the object to be found was designated verbally or presented visually. The visual method of showing the search-object gave more explicit knowledge in preparation for discovery under visual instruction. The search task was easier to carry out, the exploration was more deliberate, recognition of the search-object was more certain, and the time required for discovery was shorter than was the case of verbal instruction.

Another experiment by the same investigator<sup>1</sup> dealt with the influence of context on search. Its purpose was to study search where no clues could be obtained from the arrangement of the search field. Two types of search field were employed. One consisted of a single large picture, in which some obscure object was designated as the object to be found by the subject. This was designed to provide relevant context for the search object. Irrelevant context was secured in the other type of search field by making the field of a large collection of smaller pictures of unrelated objects, one of which was designated as the search object. It was found that search for an object surrounded by unrelated things (irrelevant context) was more difficult to carry out successfully than it was where the context was relevant with the object of the search being naturally related to its surroundings. It was also found that during the course of search there was seldom clear perception

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The results revealed that search and apprehension follow the same general course whether the object to be found was designated verbally or presented visually. The visual aided of showing the search-object gave more explicit knowledge in preparation for discovery under visual instruction. The search task was easier to carry out, the apprehension was more definite, recognition of the search-object was more certain, and the time required for discovery was shorter than was the case of verbal instruction.

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of the various things in the search field, but there was an awareness that they were not what the subject was looking for.

A further experiment was done with numbers.<sup>1</sup> It was previously demonstrated that when the subject already knows exactly the appearance of the sought object because its duplicate has been seen, then recognition in search is immediate. Thus, if the visual object is so familiar as to leave absolutely no doubt, then it seems that oral designation would be as adequate as visual designation. This supposition was tested by printed numbers. The one to be found was designated orally. The result was that immediate recognition appeared. Where a perfectly correct idea of the search object was obtained from verbal instruction there appeared no advantage in favor of visual instruction.

<sup>2</sup>  
"A Time Element" experiment used both the visual and the auditory methods of designating the search-object. A record was made of the time required for successfully completing the search task. The results indicated that under the visual method of instruction the time required to discover the search object was somewhat shorter than under verbal instruction.

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1. Kingsley, Howard L. "The Influence of Instruction and Context upon Perceptive Search", The American Journal of Psychology, Volume XLVI (July, 1934), pp. 440-441.

2. Kingsley, Howard L. "The Influence of Instruction and Context upon Perceptive Search", The American Journal of Psychology, Volume XLVI (July, 1934), pp. 441-442.

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S. Kingaley, Howard L. "The Influence of Instruction and Context upon Perceptive Search", The American Journal of Psychology, Volume XLVI (July, 1934), pp. 441-442.



## Chapter II

### Statement of the Problem

### Significance of the Problem

Number 11

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### Statement of the Problem

The purpose of this experimental study is to investigate the influence of the mode of instruction and age on the psychological function of search. The problem involves the following factors for consideration :

1. Do differences exist in search time under two different modes of instruction for children ? The two modes of instruction used are " visual "and " verbal ". In the visual instruction the subjects are shown a duplicate of an object which they are to find in the search field. In verbal instruction the object to be found by searching is simply named by the experimenter. The search time is the time which lapses between the actual beginning of the search and its termination by the discovery of the object of search.

2. Do differences exist in search time under these two different modes of instruction for adults ?

3. Will a greater difference in search time be found for children or adults between the visual and verbal modes of instruction ?

4. Does the visual or the verbal mode of instruction show the greater variability in search times, and is there a difference in variability of search times as between children and adults ?

## Statement of the Problem

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2. Do differences exist in search time under these two different modes of instruction for adults?
3. Will a greater difference in search time be found for children or adults between the visual and verbal modes of instruction?
4. Does the visual or the verbal mode of instruction show the greater variability in search time, and is there a difference in variability of search times between children and adults?



5. Is there a difference between children and adults with respect to ability to form and maintain an adequate set for search and discovery ?

6. Are there differences between children and adults with respect to the manner in which the searching process is carried out ?

#### Significance of the Problem.

While some meritorious experimental studies have been made on search, the research on this subject has been of limited quantity and has been devoted to adults only. Search is a field worthy of and ready for further experimentation. The significance of this study is two-fold. In the first place, it is the first experimental investigation of search in children. It aims to contribute some discoveries regarding the characteristic features of the searching form of activity as it appears in children. In the second place, no previous study has operated to make comparisons between children and adults in this field. This study makes such a comparison.

It should be noted here that a previous experimental<sup>1</sup> study has compared the visual and verbal instruction as sources of set for search, but that experiment used only

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3. Is there a difference between children and adults with respect to ability to form and maintain an abstract set for search and discovery?
4. Are there differences between children and adults with respect to the manner in which the searching process is carried out?

### Significance of the Problem

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It should be noted here that a previous experimental study has compared the visual and verbal functions as sources of set for search, but that experiment used only



adult subjects. The present study experiments with visual and verbal modes of instruction with adults also, but this is the first study to include children in a comparison of these two modes of instruction. The data on adults in this study have been gathered for the purpose of discovering age differences. No previous research attempted a comparison of the searching activity of children and adults.

Experimental Procedure

Subjects

Experimental Materials

Series Order

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## **Experimental Procedure**

### **Subjects**

The people who served as subjects for this experiment included two groups. The first group known as the "child group" included about eight hundred and fifty children of the Belmont Public Schools of New York City. The second group known as the "adult group" included one hundred and thirty people, namely: some teachers and one woman, university students, a few professors, and other persons of various vocations.

## **Experimental Procedure**

### **Subjects**

## **Experimental Materials**

### **Series Order**

Two Search Fields were used: these are referred to as "Box I" and "Box II". These boxes (Box I and Box II) were of uniform size (14 inches by 22 inches), same shape, and white in color. The Box covers had decorative designs of brightly colored geometrical patterns consisting of squares, circles, and triangles. They played no part in the experiment but were designed to look interesting.

The contents of the boxes (which served as the search fields) contained eight objects each. Each object was carefully selected, in its respective position. These objects of various shapes, sizes, colors, and textures in the search-task were such as could be readily identified by

Chapter III

Experimental Procedure

Subjects

Experimental Materials

Series Order



## Experimental Procedure

### Subjects

The people who served as subjects for this experiment included two groups. The first group known as the 'child group' included one hundred third grade children of the Belmont Public Schools of Massachusetts. The second group known as the 'adult group' included one hundred mature people, namely ; some business men and women, university students, a few professors, and other persons of various vocations.

### Experimental Materials

Two Search Fields were used: these are referred to as " Box I " and " Box II ". These Boxes (Box I and Box II ) were of uniform size ( 14 inches by 22 inches), same shape, and white in color. The Box covers had decorative designs of brightly colored geometrical non-descript figures . They played no part in the experiment but were designed to lend interest.

The interiors of the boxes (which served as the two search fields ) contained eighty-five small miscellaneous objects in random yet neat arrangement. Each object was safely secured, in its respective position. These objects of various shapes, sizes, colors, and kinds-used in the search-task were such as could be readily recognized by

## Experimental Procedures

### Subjects

The people who served as subjects for this experiment included two groups. The first group known as the 'child group' included one hundred third grade children of the Belmont Public Schools of Massachusetts. The second group known as the 'adult group' included one hundred mature people, namely: some business men and women, university students, a few professors, and other persons of various vocations.

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any children of the third grade level as well as by all adults. A small safety pin in Box I and an average looking button in Box II were the objects to be found in their respective search fields.

### Procedure

The writer served as examiner throughout the experiment. By means of a stop-watch a careful record was made of the seconds required by each subject to discover the designated object in each search field. Each subject stood in front of the Boxes so as to have a comfortable and accessible view of the contents immediately the lid was removed. Each performed his search-task individually. Experimental procedures were the same for each except for the variations in procedures for the groups described below.

### The Four Series

In order to balance practice effects between the two forms of instruction, provision was made for having one-half of the subjects operate under visual instruction first and under verbal instruction second ; while the other half operated under verbal instruction first, with visual instruction coming second in order. Also in order to balance for the two forms of instruction any possible inequalities of difficulty for the two tasks

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### The Four Series

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( search in Box I and search in Box II ) it was arranged to have visual instruction used with Box I by half of the subjects while the other half used Box II with visual instruction. Likewise the use of verbal instruction was equally divided between the two Boxes. These variations in procedure were secured by dividing the one hundred children into four groups of twenty-five each, designated as A, B, C, and D with a separate experimental series for each which correspondingly are indicated as Series 1, 2, 3, and 4.

Thus for the children we have :

Series 1 , Group A , 25 children .

Series 2 , Group B , 25 children .

Series 3 , Group C , 25 children .

Series 4 , Group D , 25 children .

A corresponding grouping was made for the one hundred adult subjects, with a similar set of four series.

The procedure with respect to order of presentation of the visual and the verbal modes of instruction and the Boxes used with them for the four groups of children and the four groups of adults were then as follows :

1. Group A , Series 1 , first were given the Visual instruction with Box I and then the Verbal instruction with Box II .

(series in Box I and series in Box II) it was arranged  
 to have visual instruction used with Box I by half of  
 the subjects while the other half used Box II with visu-  
 al instruction. Likewise the use of verbal instruction  
 was equally divided between the two boxes. These vari-  
 ations in procedure were covered by dividing the one  
 hundred children into four groups of twenty-five each,  
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 tal series for each which corresponded only to indicated  
 as Series I, B, C, and A.

Thus for the children we have:

- Series I, Group A, 25 children
- Series B, Group B, 25 children
- Series C, Group C, 25 children
- Series D, Group D, 25 children

A corresponding grouping was made for the one hun-  
 dred adult subjects, with a similar set of four series.  
 The procedure with respect to order of presentation  
 of the visual and the verbal modes of instruction and  
 the boxes used with them for the four groups of child-  
 ren and the four groups of adults were then as follows:  
 1. Group A, Series I, first were given the  
 Visual instruction with Box I and then the  
 Verbal instruction with Box II.



2. Group B , Series 2 , first were given the Verbal instruction with Box II and then the Visual instruction with Box I .
3. Group C , Series 3 , first had Verbal instruction with Box I and then Visual instruction with Box II .
4. Group D , Series 4 , first had Visual instruction with Box II and then Verbal instruction with Box I .

These procedures are summarized in Table A .

3. Group 3, Series 3, First were given the  
Verbal instruction with Box II and then the  
Visual instruction with Box I.

3. Group 3, Series 3, First had Verbal instruc-  
tion with Box I and then Visual instruction  
with Box II.

4. Group 3, Series 4, First had Visual instruc-  
tion with Box II and then Verbal instruction  
with Box I.

These procedures are summarized in Table A.



Table A

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**Order of Procedure for the Four Series conducted for  
Both Children and Adults**

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	<u>Group A</u>	<u>Series 1</u>	
(1) Box I	Visual	Instruction	25 Subjects
(2) Box II	Verbal	Instruction	
	<u>Group B</u>	<u>Series 2</u>	
(1) Box II	Verbal	Instruction	25 Subjects
(2) Box I	Visual	Instruction	

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	<u>Group C</u>	<u>Series 3</u>	
(1) Box I	Verbal	Instruction	25 Subjects
(2) Box II	Visual	Instruction	
	<u>Group D</u>	<u>Series 4</u>	
(1) Box II	Visual	Instruction	25 Subjects
(2) Box I	Verbal	Instruction	

---

Table 1

Order of Experiments for the Four Series conducted for  
Each Child and Adult

Group A Series 1		Group B Series 2	
22 Subjects	Verbal	Verbal	(1) Box I
	Instruction	Instruction	(2) Box II
Group B Series 3		Group A Series 4	
22 Subjects	Verbal	Verbal	(1) Box II
	Instruction	Instruction	(2) Box I
Group C Series 5		Group D Series 6	
22 Subjects	Verbal	Verbal	(1) Box I
	Instruction	Instruction	(2) Box II
Group D Series 7		Group E Series 8	
22 Subjects	Verbal	Verbal	(1) Box II
	Instruction	Instruction	(2) Box I

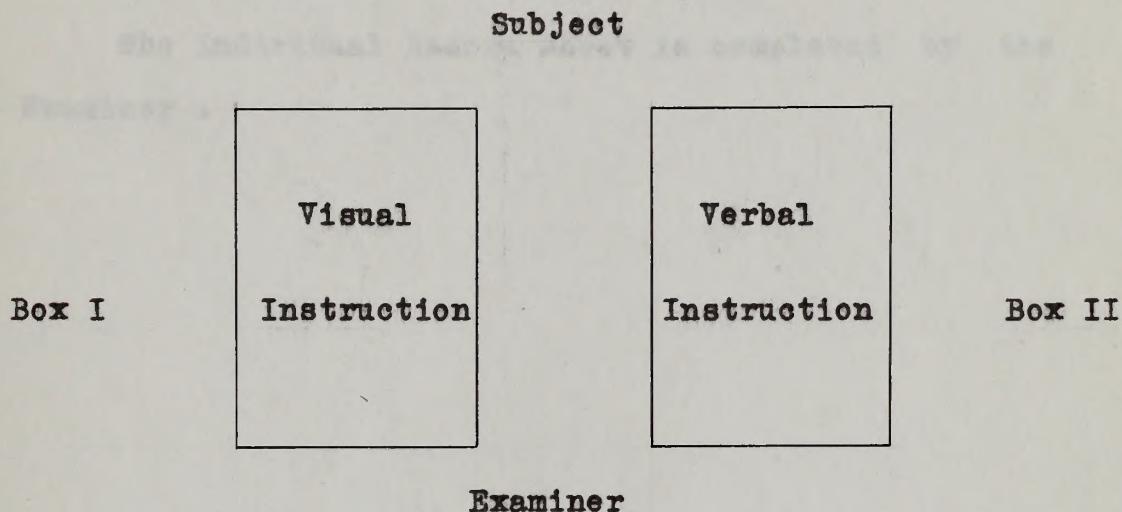


Children

Group A

Series 1.

The first series of twenty-five subjects entered into the Search-Task to discover the designated object in the following manner :



Examiner says : " I have here a Box (designating covered Box I ) . Inside of it are many small things. One of them is just like this ( show a small safety pin ). When I take the cover off the Box , you are to find as quickly as possible the one like this. When you find it , point to it and say 'There'. Do you understand ? Ready- Now." Examiner removes the cover from the Box. Examiner records the search time required to find the designated object.

Examiner again says : " I have here another Box (designating covered Box II ). Inside of it are many small things. I will name what you are to find. When I name it you are to

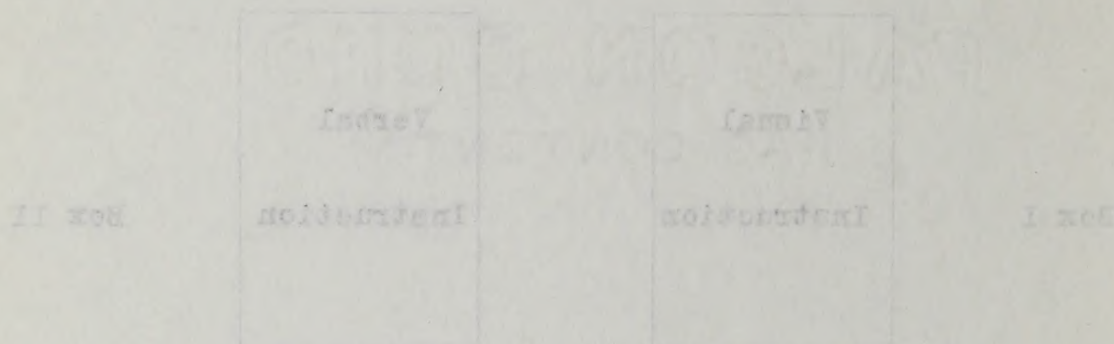
Series I.

Group A

Children

The first series of twenty-five subjects entered into the Search-Test to discover the designated object in the following manner:

Subject



Examiner

Examiner says: "I have here a box (designating covered Box I). Inside of it are many small things. One of them is just like this (show a small safety pin). When I take the cover off the box, you are to find as quickly as possible the one like this. When you find it, point to it and say 'There'. Do you understand? Ready-Now."

Examiner removes the cover from the box. Examiner records the search time required to find the designated object.

Examiner again says: "I have here another box (designating covered Box II). Inside of it are many small things. I will name what you are to find. When I name it you are to



find it as quickly as possible. When you see it, point to it and say 'There '. Ready ? " Simultaneously the examiner removes the cover from Box II and says, "Find the Button ." The examiner records the search time required to find the designated object.

The Individual Record Sheet is completed by the Examiner .

find it as easily as possible. When you see it, point  
to it and say "There". Ready? "Blindly" immediately the  
examiner removes the cover from box II and says, "Find  
the button." The examiner records the search time  
required to find the designated object.  
The Individual Record Sheet is completed by the  
Examiner.



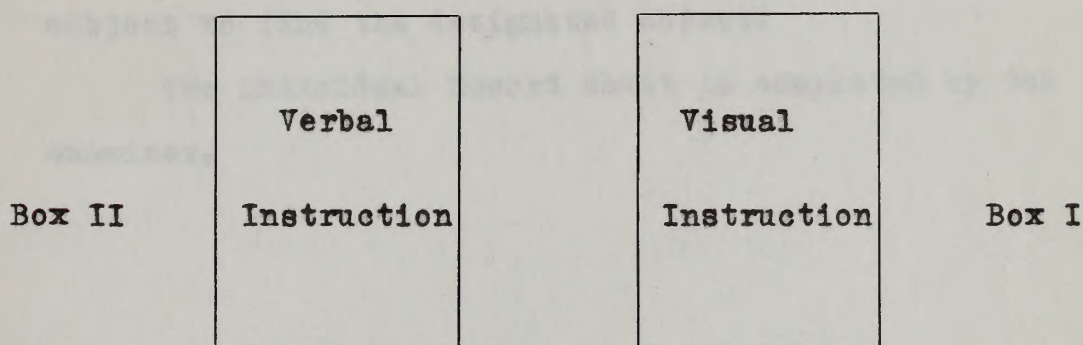
Children

Group B

Series 2 .

The second series of twenty-five subjects entered into the Search-Task to discover the designated object in the following manner :

Subject



Examiner

Examiner says : " I have here a Box ( designating covered Box II ). Inside of it are many small things. I will name what you are to find. When I name it you are to find it as quickly as possible. When you see it, point to it and say, 'There '. Ready ? " Simultaneously, the examiner removes the cover from Box II and says ... " Find the Button." The examiner records the search time required to find the designated object.

Examiner again says : " I have here another Box ( designating covered Box I ) . Inside of it are many

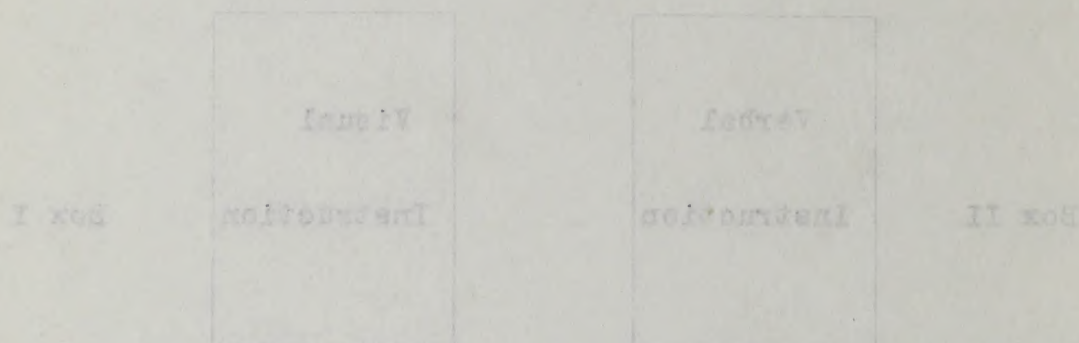
Children

Group 2

Group 3

The second series of twenty-five subjects entered into the search-task to discover the designated object in the following manner:

Subjects



Examiner

Examiner says: "I have here a box (designating covered Box II). Inside of it are many small things. I will name what you are to find. When I name it you are to find it as quickly as possible. When you see it, point to it and say, 'There'." Ready? "Simultaneously, the examiner removes the cover from Box II and says: "... Find the button." The examiner records the search time required to find the designated object.

Examiner again says: "I have here another box (designating covered Box I). Inside of it are many



small things. One of them is just like this. (Show a small safety pin ). When I take the cover off the Box, you are to find it as quickly as possible. When you see it point to it and say ' There '. Do you understand ? Ready...Now." Examiner then removes the cover of Box I and records the time required by the subject to find the designated object.

The Individual Record Sheet is completed by the examiner.

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The individual Record Sheet is completed by the

examiner.



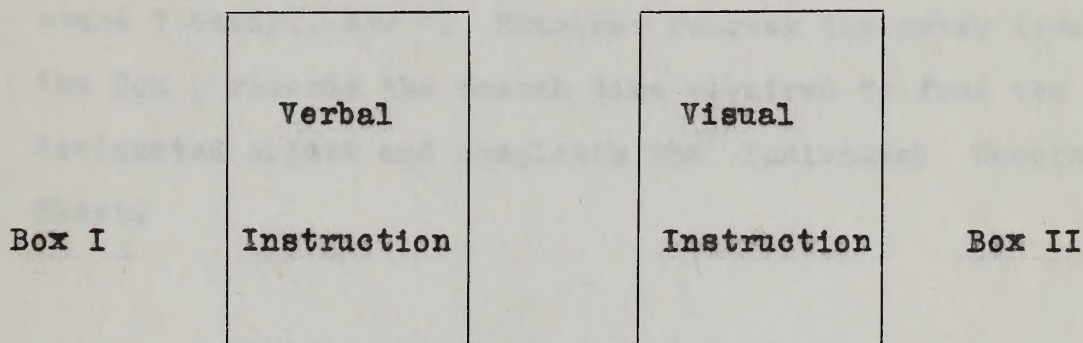
Children

Group C

Series 3 .

The third series of twenty-five subjects entered upon the Search-Task to discover the designated object in the following manner :

Subject



Examiner

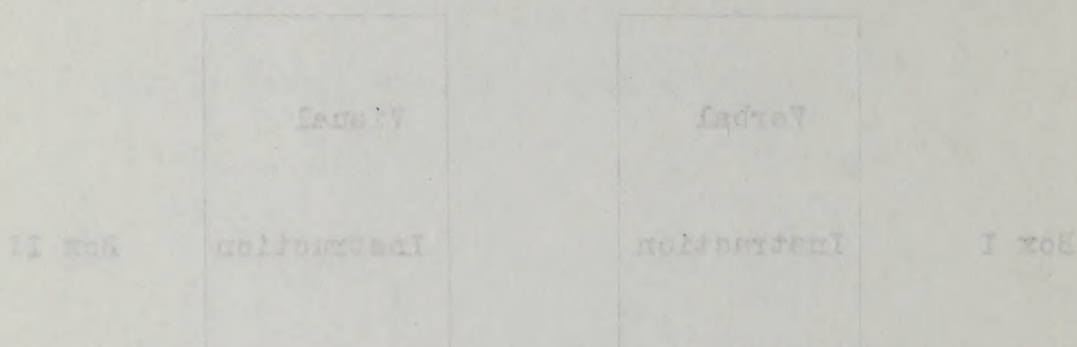
Examiner says : " I have here a Box ( designating covered Box I ). Inside of it are many small things. I will name what you are to find. When I name it you are to find it as quickly as possible . When you see it, point to it and say ' There '. Ready ? " Simultaneously, the examiner removes the cover from Box I and says .... " Find the safety pin." Examiner records the search time required to find the designated object.

The Individual Record Sheet is completed by the examiner.

Observer Group 2 Review 3

The first series of twenty-five subjects entered upon the Search-Task to discover the designated object in the following manner:

Subject



Examiner

Examiner says: "I have here a Box (designating covered Box I). Inside of it are many small objects. I will name what you are to find. When I name it you are to find it as quickly as possible. When you see it, point to it and say 'There'. Ready?" (Simultaneously, the examiner removes the cover from Box I and says .... "Find the safety pin." Examiner records the search time required to find the designated object.

The Individual Record Sheet is completed by the

examiner.



Examiner again says : " I have here another Box ( designating covered Box II ) . Inside of it are many small things. One of them is just like this ( show a button ). When I take the cover off the Box, you are to find as quickly as possible the one like this. When you find it, point to it and say ' There '. Do you understand ? Ready...Now ". Examiner removes the cover from the Box , records the search time required to find the designated object and completes the Individual Record Sheet.

Box II

Instruction

Instruction

Box I

Examiner

Examiner says : " I have here a Box ( designating covered Box II ). Inside of it are many small things; One of them is just like this, (Show the button ). When I take the cover off the Box, you are to find as quickly as possible the one like this. When you find it, point to it and say ' There '. Do you understand? Ready...Now ". Examiner removes the cover from the Box and records the search time required to find the designated object.

Examiner again says : " I have here another Box

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 ( Designating covered box II ) . Inside of it are many  
 small things. One of them is just like this ( show a  
 button ) . When I take the cover off the box, you are to  
 find as quickly as possible the one like this. When you  
 find it, point to it and say ' There ' . Do you under-  
 stand ? Ready... Now " . Examiner removes the cover from  
 the box, records the search time required to find the  
 designated object and completes the Individual Record  
 Sheet.



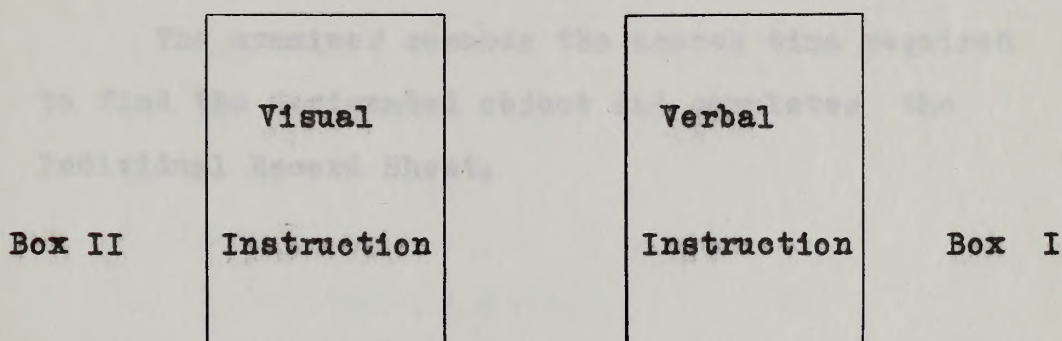
Children

Group D

Series 4 .

The fourth series of twenty-five subjects entered into the Search-Task to discover the designated object in the following manner :

Subject



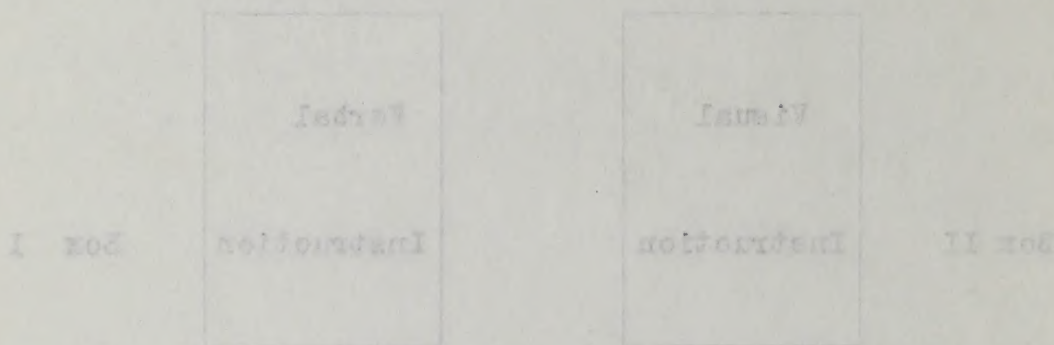
Examiner

Examiner says : " I have here a Box ( designating covered Box II ). Inside of it are many small things. One of them is just like this. (Show the button ). When I take the cover off the Box, you are to find as quickly as possible the one like this. When you find it, point to it and say ' There '. Do you understand? Ready...Now ". Examiner removes the cover from the Box and records the search time required to find the designated object.

Examiner again says : " I have here another Box

The fourth series of twenty-five subjects entered into the Search-Task to discover the designated object in the following manner:

Subject



Examiner

Examiner says: "I have here a box I designate covered Box II. Inside of it are many small things. One of them is just like this. (Show the button). When I take the cover off the box, you are to find as quickly as possible the one like this. When you find it, point to it and say 'There'. Do you understand? Ready... Now". Examiner removes the cover from the box and records the search time required to find the designated object.

Examiner again says: "I have here another box



( designating covered Box I ). Inside of it are many small things. I will name what you are to find. When I name it you are to find it as quickly as possible. When you see it point to it and say ' There '. Ready?" Simultaneously, the examiner removes the cover from Box I and says " Find the safety pin ".

2. Name.

The examiner records the search time required to find the designated object and completes the Individual Record Sheet.

7. School grade.

8. Intelligence Quotient.

9. Mental Age.

10. Time to complete Search-Task (record in seconds).

11. Eye patterns.

12. Observations such as attitude, method of attack of problem, approach, facial expressions, bodily movements, posture.

13. Notations of ability to maintain the task.

14. Recordings of promptings and urgings (if any), verbal and tactual kinesthetic, and remarks (particularly regarding the concept of the search object).

A copy of the record sheet is presented on page 100.

The entire procedure as here stated for the children's groups was used in identical order and detail for the adult groups.

(designating covered Box I) . Inside of it are many small things. I will name what you are to find. When I name it you are to find it as quickly as possible. When you see it point to it and say 'There' . 'Ready?' Simultaneously, the examiner removes the cover from Box I and says "Find the safety pin" .

The examiner records the search time required

to find the designated object and completes the

Individual Record Sheet.



### Individual Records

An Individual Record was kept for each child and adult to include the following data :

1. Group and series number.
2. Date of the experiment.
3. Name.
4. Age.
5. Date of Birth.
6. Sex.
7. School grade.
8. Intelligence Quotient.
9. Mental Age.
10. Time to complete Search-Task (record in seconds).
11. Eye patterns.
12. Observations such as attitude, method of attack of problem, approach, facial expressions, bodily movements, posture.
13. Notations of ability to maintain the task.
14. Recordings of promptings and urgings (if any), verbal and tactual kinaesthesia, and remarks (particularly regarding the concept of the search object).

A copy of the record sheet is presented on page 100.

The entire procedure as here stated for the children's groups was used in identical order and detail for the adult groups.

# Individual Records

An Individual Record was kept for each child and

adult to include the following data:

1. Group and series number.
2. Date of the experiment.
3. Name.
4. Age.
5. Date of Birth.
6. Sex.
7. School Grade.
8. Intelligence Quotient.
9. Mental Age.
10. Time to complete Search-Task (record in seconds).
11. Eye patterns.
12. Observations such as attitude, method of attack of problem, approach, facial expressions, bodily movements, posture.
13. Notations of ability to maintain the task.
14. Recordings of promptings and ratings (if any), verbal and facial kinesics, and remarks (particularly regarding the concept of the search object).

A copy of the record sheet is presented on page 100.

The entire procedure as here stated for the children's

groups was used in identical order and detail for the

adult groups.



## **Chapter IV**

**Data and Discussion**

### **Results**

**(1) Data and Discussion**

**(2) Observations on the Search Performance**

## Chapter IV

### Results

- (1) Data and Discussion
- (2) Observations on the Search Performance



## Data and Discussion

Experimental conditions being the same for children and adults, like data were collected for all subjects.

Table I, page 47, shows the visual and verbal search times for children, Group A, Series I. The range of the visual scores is from 5 to 30 seconds. The verbal scores show a much larger range from 0.3 to 145 seconds. The mean of the visual scores is 11.4 with a standard deviation of 4.1. The mean of the verbal scores is 30.33 with a standard deviation of 30.4.

The reason for the great difference in means and standard deviations between the two methods (visual and verbal) is due to a few extremely high scores in the verbal distribution; for example, the case of 145 seconds, and one case of 30 seconds, and the next highest case of 155 seconds.

By the generally accepted technique for showing the difference between the two methods, the critical ratio was established. The critical ratio as established by the difference of the means is 1.44. It is not entirely statistically significant, but (by interpretation) shows that there are 33 chances in 100 that it is a true difference. The visual method is the more favored method.

Date and Discussion



## Data and Discussion

Experimental conditions being the same for Children and Adults , like data were collected for all subjects.

Table I ,page 47, shows the visual and verbal search time scores for Children, Group A , Series 1. The range of the visual scores is from 2 to 25 seconds. The verbal scores show a much larger range from 0.5 to 145 seconds. The mean of the visual scores is 10.38 with a standard deviation of 6.1 . The mean of the verbal scores is 20.28 with a standard deviation of 30.4.

The reason for the great difference in means and standard deviations between the two methods (visual and verbal) is due to a few extremely high scores in the verbal distribution; for example, the case of 45 seconds, one case at 80 seconds, and the most extreme case of 145 seconds.

By the generally accepted technique for showing the differences between the two methods, the critical ratio was established. The critical ratio as established by the differences of the means is 1.44 . It is not entirely statistically significant, but (by interpolation) shows that there are 93 chances in 100 that it is a true difference. The visual method is the more favored method.

## Data and Discussion

Experimental conditions being the same for children and adults, like data were collected for all subjects. Table I, page 47, shows the visual and verbal search time scores for children, Group A, Series I. The range of the visual scores is from 8 to 25 seconds. The verbal scores show a much larger range from 0.5 to 145 seconds. The mean of the visual scores is 10.38 with a standard deviation of 5.1. The mean of the verbal scores is 30.38 with a standard deviation of 30.4. The reason for the great difference in means and standard deviations between the two methods (visual and verbal) is due to a few extremely high scores in the verbal distribution; for example, the case of 45 seconds, one case at 80 seconds, and the most extreme case of 145 seconds. By the generally accepted technique for showing the difference between the two methods, the critical ratio was established. The critical ratio as established by the difference of the means is 1.44. It is not entirely statistically significant, but (by interpolation) shows that there are 35 chances in 100 that it is a true difference. The visual method is the more favored method.



Table I Shows Time Scores in Seconds for  
Children                      Group A                      Series 1.

Subjects	Visual Instruction	Verbal Instruction
	Box I	Box II
1	11	2
2	7.5	80
3	5	28
4	12.5	3
5	18	7
6	6.5	45
7	7	7
9	10	13
10	9	5
11	11	14
12	22	145
13	2	20
14	11	3
15	7	9
16	4	4
17	25	17
18	11	16
19	7	3
20	9	21
21	6	7
22	25	12
23	7	0.5
24	6	20
25	11	3
N	25	25
Range	2-----25	0.5-----145
Mean	10.38	20.28
S.D.dis	6.1	30.4
S.E.m	1.22	6.8
Diff.of means		9.9
S.E.D.m		6.18
Critical Ratio		1.44
First Quartile	11	20
Median	9	12
Third Quartile	7	4
Q	2	8
S.E.mdn	1.53	8.5
Diff. of medians		3
S.E.D.mdn		8.63
Critical Ratio		.35

Table 1. Shows the results of the analysis of variance.

Group A      Group B      Group C

Box I	Box II	Box III
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9
10	10	10
11	11	11
12	12	12
13	13	13
14	14	14
15	15	15
16	16	16
17	17	17
18	18	18
19	19	19
20	20	20
21	21	21
22	22	22
23	23	23
24	24	24
25	25	25
26	26	26
27	27	27
28	28	28
29	29	29
30	30	30
31	31	31
32	32	32
33	33	33
34	34	34
35	35	35
36	36	36
37	37	37
38	38	38
39	39	39
40	40	40
41	41	41
42	42	42
43	43	43
44	44	44
45	45	45
46	46	46
47	47	47
48	48	48
49	49	49
50	50	50
51	51	51
52	52	52
53	53	53
54	54	54
55	55	55
56	56	56
57	57	57
58	58	58
59	59	59
60	60	60
61	61	61
62	62	62
63	63	63
64	64	64
65	65	65
66	66	66
67	67	67
68	68	68
69	69	69
70	70	70
71	71	71
72	72	72
73	73	73
74	74	74
75	75	75
76	76	76
77	77	77
78	78	78
79	79	79
80	80	80
81	81	81
82	82	82
83	83	83
84	84	84
85	85	85
86	86	86
87	87	87
88	88	88
89	89	89
90	90	90
91	91	91
92	92	92
93	93	93
94	94	94
95	95	95
96	96	96
97	97	97
98	98	98
99	99	99
100	100	100



However, because of extreme skewness of the verbal scores, there is here applied another technique of showing differences between two methods.<sup>1</sup>

Because similar conditions of skewness are found in the verbal distributions of future series these additional techniques for showing differences have been used.

The critical ratio as established by the differences between medians is .35 and it is considerably lower than the critical ratio of 1.44, established by the means ; therefore, a further method of showing the reliability of the difference is attempted by the standard error of the difference between correlated medians.<sup>2</sup> The critical ratio here results in .34 , and is not materially affected by correlating the visual and the verbal scores.

Figure 1 shows the distribution of visual and verbal time scores for Children, Group A, Series 1. The range for the visual scores is 2---25 seconds and 0.5---145 seconds for the verbal scores.

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1. Peters, Charles C. and Van Voorhis, Walter R.  
Statistical Procedures and Their Mathematical Bases.  
pp.160-190.

2. Garrett, Henry E. Statistics in Psychology and Education. p.218.

However, because of extreme skewness of the verbal scores, there is here applied another technique of showing differences between two methods.

Because similar conditions of skewness are found in the verbal distributions of future series these additional techniques for showing differences have been used.

The critical ratio as established by the differences between medians is .35 and it is considerably lower than the critical ratio of 1.44, established by the means; therefore, a further method of showing the reliability of the difference is attempted by the standard error of the difference between correlated medians. The critical ratio here results in .84, and is not materially affected by correlating the visual and the verbal scores.

Figure 1 shows the distribution of visual and verbal time scores for Children, Group A, Series I. The range for the visual scores is 2---23 seconds and 0.5---1.5 seconds for the verbal scores.

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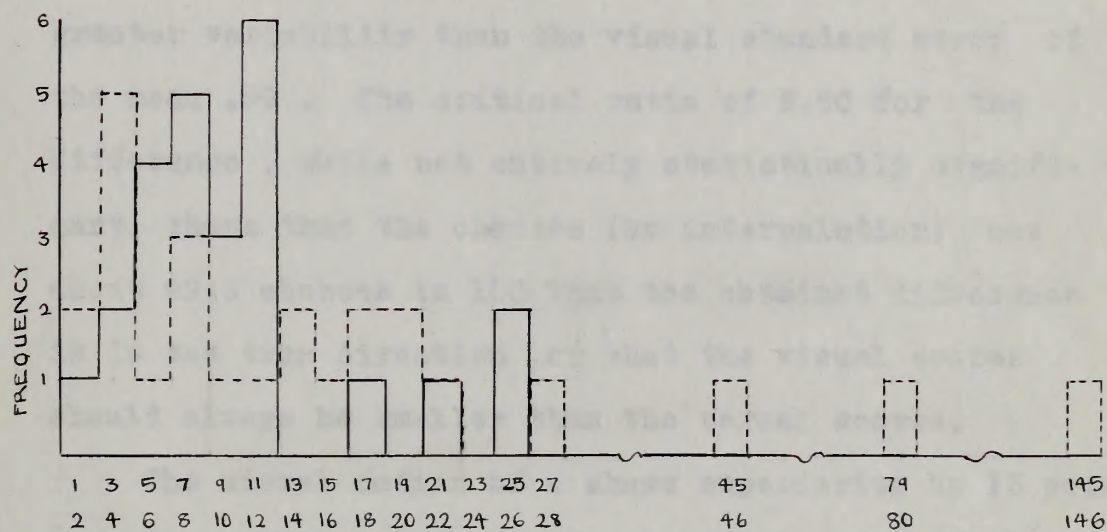
1. Peters, Charles G. and Van Voorhis, Walter H.  
Statistical Procedures and Their Mathematical Basis.  
 pp. 150-155.

2. Garroff, Henry E. Statistics in Psychology and Education.  
 p. 218.



Figure 1

Distribution of Visual and Verbal Time Scores  
for  
Children Group A Series 1



Time Scores in Seconds

—— VISUAL FREQUENCY BOX I  
----- VERBAL FREQUENCY BOX II





Table II, page 51, shows the visual and the verbal time scores in seconds for Children, Group B ,Series 2. The range for visual scores from 0.5 to 25 shows very much less range than the verbal score range of 1.5 to 300 seconds. The one case of 300 seconds for the verbal is a spurious case; however, still there are other cases for the verbal, requiring 50 seconds, 60 seconds, and even two cases require some 80 seconds which tend to cause a very much higher range than the 25 seconds which is the highest score for the visual. The visual mean shows superiority by 30.20 points over the verbal mean. The standard error of the mean for verbal 11.66 shows greater variability than the visual standard error of the mean .99 . The critical ratio of 2.60 for the difference , while not entirely statistically significant, shows that the chances (by interpolation) are about 99.6 chances in 100 that the obtained difference is in the true direction ,or that the visual scores should always be smaller than the verbal scores.

The visual median of 4 shows superiority by 13 points over the verbal median of 17. The middle 50% of the verbal scores ranged from 8 to 45 seconds and from 3 to 8 seconds for the visual. This series like the former series show the difference in means and medians to favor the visual scores.



Table II, page 51, shows the visual and the verbal time scores in seconds for Children, Group B, Series 2. The range for visual scores from 0.5 to 25 shows very much less range than the verbal scores range of 1.5 to 300 seconds. The one case of 300 seconds for the verbal is a spurious case; however, still there are other cases for the verbal, reaching 60 seconds, 80 seconds, and even two cases require some 90 seconds which tend to raise a very much higher range than the 25 seconds which is the highest score for the visual. The visual mean shows superiority of 30.80 points over the verbal mean. The standard error of the mean for verbal 11.66 shows greater variability than the visual standard error of the mean, 9.9. The critical ratio of 2.60 for the difference, while not strictly statistically significant, does show that the chances (by interpolation) are about 99.8 chances in 100 that the obtained difference is in the true direction, or that the visual scores should always be smaller than the verbal scores. The visual median of 4 shows superiority of 13 points over the verbal median of 17. The middle 50% of the verbal scores ranged from 2 to 45 seconds and from 2 to 8 seconds for the visual. This series like the former series show the difference in means and medians to favor the visual scores.



Table II Shows Time Scores in Seconds for  
Children Group B Series 2.

Subjects	Verbal Instruction	Visual Instruction
	Box II	Box I
1	17	13
2	25	10
3	10	1.5
4	33	5
5	65	3
6	12	1.5
7	45	5.5
8	80	8
9	6	2
10	85	3.5
11	4	5.5
12	25	9
13	50	3
14	10	7
15	8	3
16	16	9
17	7	4
18	26	25
19	33	6
20	1.5	3
21	9.5	3
22	17	1
23	5	2
24	3	0.5
25	300	4
N	25	25
Range	1.5---300	0.5---25
Mean	35.72	5.52
S.D. dis	58.31	4.97
S.E.m	11.66	.99
Diff. of means		30.20
S.E. D.m		11.27
Critical Ratio		2.60
First Quartile	45	8
Median	17	4
Third Quartile	8	3
Q	19	3
S.E. mdn	14.58	1.24
Diff. of medians		13.
S.E. D.mdn		14.63
Critical Ratio		.83

Table II Shows Time Scores in Seconds for

Children Group B Series A.

Subjects	Box II	Box I
1	19	18
2	26	19
3	19	1.5
4	23	4
5	26	3
6	12	1.5
7	48	5.5
8	80	8
9	6	2
10	26	3.5
11	4	5.5
12	26	3
13	20	3
14	19	7
15	8	3
16	18	9
17	7	4
18	22	26
19	23	6
20	1.5	2
21	2.5	3
22	19	1
23	5	2
24	2	0.5
25	500	4
<hr/>		
Range	1.5--500	0.5--26
Mean	22.72	5.58
S.D. 11.5	28.21	4.27
S.E. 3.6	11.62	.99
<hr/>		
Diff. of means		50.20
S.E. 11.27		11.27
Critical Ratio		2.80
<hr/>		
First Quartile	48	8
Median	19	4
Third Quartile	8	3
S.E. 14.55	19	3
S.E. 1.24		1.24
<hr/>		
Diff. of medians		13.
S.E. 14.62		14.62
Critical Ratio		.88



Figure 2 shows the distribution of visual and verbal time scores in seconds for Children, Group B , Series 2 . The visual scores range from 0.5 to 25 seconds and the verbal scores range from 1.5 to 300 seconds.

Table III, page 54 , shows the visual and verbal time scores in seconds for Children, Group C , Series 3. The range of the visual scores is 0.5 to 13 seconds with a mean of 3.39 . The range of the verbal scores is 2 to 240 seconds. The lowest verbal score of 2.0 seconds is four times the lowest visual score of 0.5 seconds. The highest verbal score of 240 seconds is approximately seventeen times the highest visual score. The verbal mean of 22.82 is 19.43 points larger than the visual mean of 3.39. Also the standard deviation 46.06 for the verbal is much greater than the standard deviation of 2.95 for the visual, which shows greater variability for the verbal. The critical ratio of 2.11 , while not statistically significant , shows the difference in favor of the visual and (by interpolation) the chances are 98 in 100 that this is a true difference.

Because of the spurious case of 240 seconds for the verbal, by another measure we find that the middle 50% of the cases for verbal lie between 6 and 23 seconds. The data show the visual scores to be less variable. The middle 50% of the visual scores lie between 1.5 and 4

Figure 2 shows the distribution of visual and verbal time scores in seconds for Children, Group B, Series 2. The visual scores range from 0.5 to 22 seconds and the verbal scores range from 1.5 to 200 seconds.

Table III, page 54, shows the visual and verbal time scores in seconds for Children, Group C, Series 2. The range of the visual scores is 0.5 to 12 seconds with a mean of 3.33. The range of the verbal scores is 2 to 240 seconds. The lowest verbal score of 2.0 seconds is four times the lowest visual score of 0.5 seconds. The highest verbal score of 240 seconds is approximately seventeen times the highest visual score. The verbal mean of 22.22 is 12.43 points larger than the visual mean of 3.33. Also the standard deviation 45.03 for the verbal is much greater than the standard deviation of 3.33 for the visual, which shows greater variability for the verbal. The critical ratio of 2.11, while not statistically significant, shows the difference in favor of the visual and (by interpolation) the chances are 98 in 100 that this is a true difference.

Because of the spurious case of 240 seconds for the verbal, by another measure we find that the middle 50% of the cases for verbal lie between 6 and 22 seconds. The data show the visual scores to be less variable. The middle 50% of the visual scores lie between 1.5 and 4



Figure 2

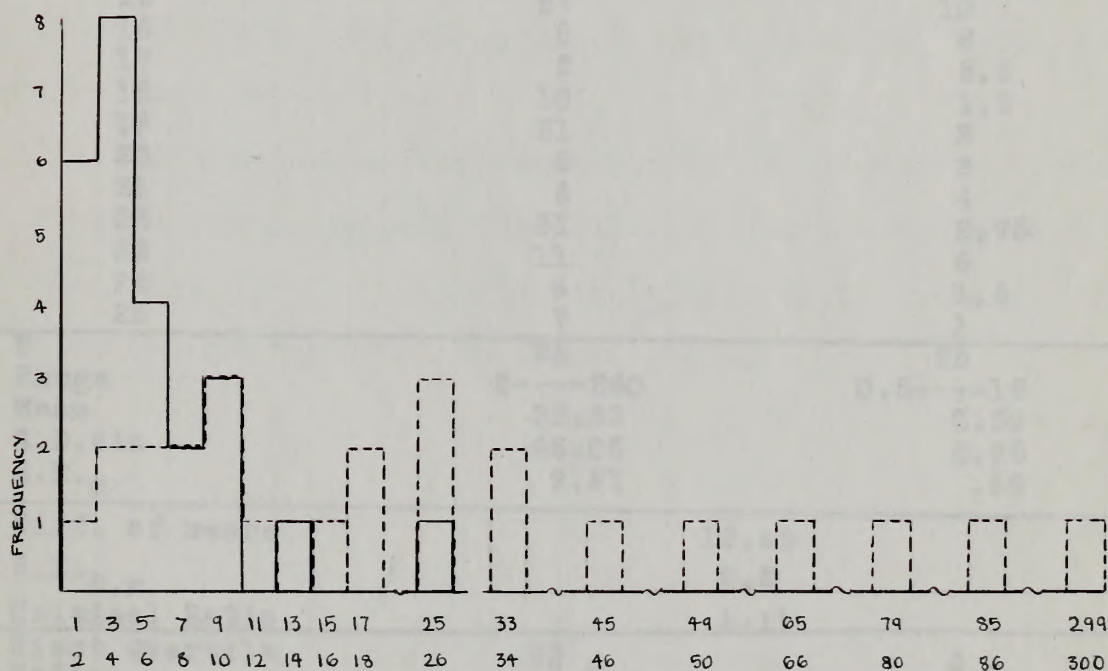
Distribution of Visual and Verbal Time Scores

for

Children

Group B

Series 2



Time Scores in Seconds

—— VISUAL FREQUENCY BOX I

- - - - VERBAL FREQUENCY BOX II





Table III Shows Time Scores in Seconds for

Children Subjects	Group C	
	Verbal Instruction Box I	Series 3. Visual Instruction Box II
1	6	13
2	240	1
3	17	4
4	8	2
5	9.5	2
6	8.5	2
7	10	3
8	20	3
9	11.5	0.5
10	2	1
11	60	1.5
12	4	4
13	23	1.5
14	9	3
15	27	10
16	5	8
17	2	3.5
18	10	1.5
19	31	3
20	6	2
21	6	4
22	31	2.75
23	11	6
24	6	1.5
25	7	1
N	25	25
Range	2-----240	0.5-----13
Mean	22.82	3.39
S.D. dis	46.06	2.95
S.E. m	9.21	.59
Diff. of means		19.43
S.E. D.m		9.2
Critical Ratio		2.11
First Quartile	23.5	4.5
Median	6	1.5
Third Quartile	8.5	1.25
Q	11.51	.64
S.E. mdn		
Diff. of medians		7.
S.E. D.mdn		11.53
Critical Ratio		.61

Table III Shows Time Scores in Seconds for

Children		Group B		Series A	
Subjects		Box I		Box II	
1	18	8	18	1	18
2	20	240	1	1	1
3	17	17	4	4	4
4	8	8	8	8	8
5	2.5	2.5	2	2	2
6	2.5	2.5	2	2	2
7	10	10	3	3	3
8	20	20	3	3	3
9	11.5	11.5	0.5	0.5	0.5
10	2	2	1	1	1
11	20	20	1.5	1.5	1.5
12	4	4	4	4	4
13	28	28	1.5	1.5	1.5
14	2	2	8	8	8
15	27	27	10	10	10
16	5	5	8	8	8
17	2	2	2.5	2.5	2.5
18	10	10	1.5	1.5	1.5
19	27	27	3	3	3
20	2	2	2	2	2
21	2	2	4	4	4
22	27	27	2.75	2.75	2.75
23	17	17	2	2	2
24	2	2	1.5	1.5	1.5
25	7	7	1	1	1
Range		25--240		0.5--15	
Mean		22.82		2.82	
S.E.M.		2.08		2.08	
Diff. of means		9.21		.69	
S.E.D.M.		19.48		2.48	
Critical Ratio		2.11		2.11	
First Quartile		22.5		2.5	
Median		2		1.5	
Third Quartile		2.5		1.25	
S.E.M.		11.21		.64	
Diff. of medians		7		7	
S.E.D.M.		11.28		11.28	
Critical Ratio		.61		.61	



seconds. This series like series 1 and series 2 show the difference to be in favor of the visual form of instruction.

Using this series for another sampling to see if the critical ratio obtained by correlating the two methods (visual and verbal) is materially affected, the following is solved by the formula: "standard error of the difference between correlated medians."  $r = -1.31$  and  $\text{difference}_{\text{mdn}} = 12.34$ . The difference of the medians is 7 and the critical ratio of .57 is not materially different from the critical ratio of .61 as obtained from uncorrelated medians. The chances are about 73 in 100 that this is a true difference.

Figure 3 shows the distribution of visual and verbal time scores in seconds for Children, Group C, Series 3. The range for the visual scores is 0.5 to 13 seconds, and 2 to 240 seconds for the verbal scores.

seconds. This series like series 1 and series 2 show the difference to be in favor of the visual form of presentation. Using this series for another sampling to see if the critical ratio obtained by correlating the two methods (visual and verbal) is materially affected, the following is solved by the formula: "standard error of the difference between correlated medians."  $\Delta = -1.81$  and  $\Delta_{crit} = 1.84$ . The difference of the medians is 7 and the critical ratio of .67 is not materially different from the critical ratio of .61 as obtained from uncorrelated medians. The chances are about 73 in 100 that this is a true difference.

Figure 3 shows the distribution of visual and verbal time scores in seconds for Children, Group C, Series 3. The range for the visual scores is 0.5 to 1.5 seconds, and 2 to 2.5 seconds for the verbal scores.



Figure 3

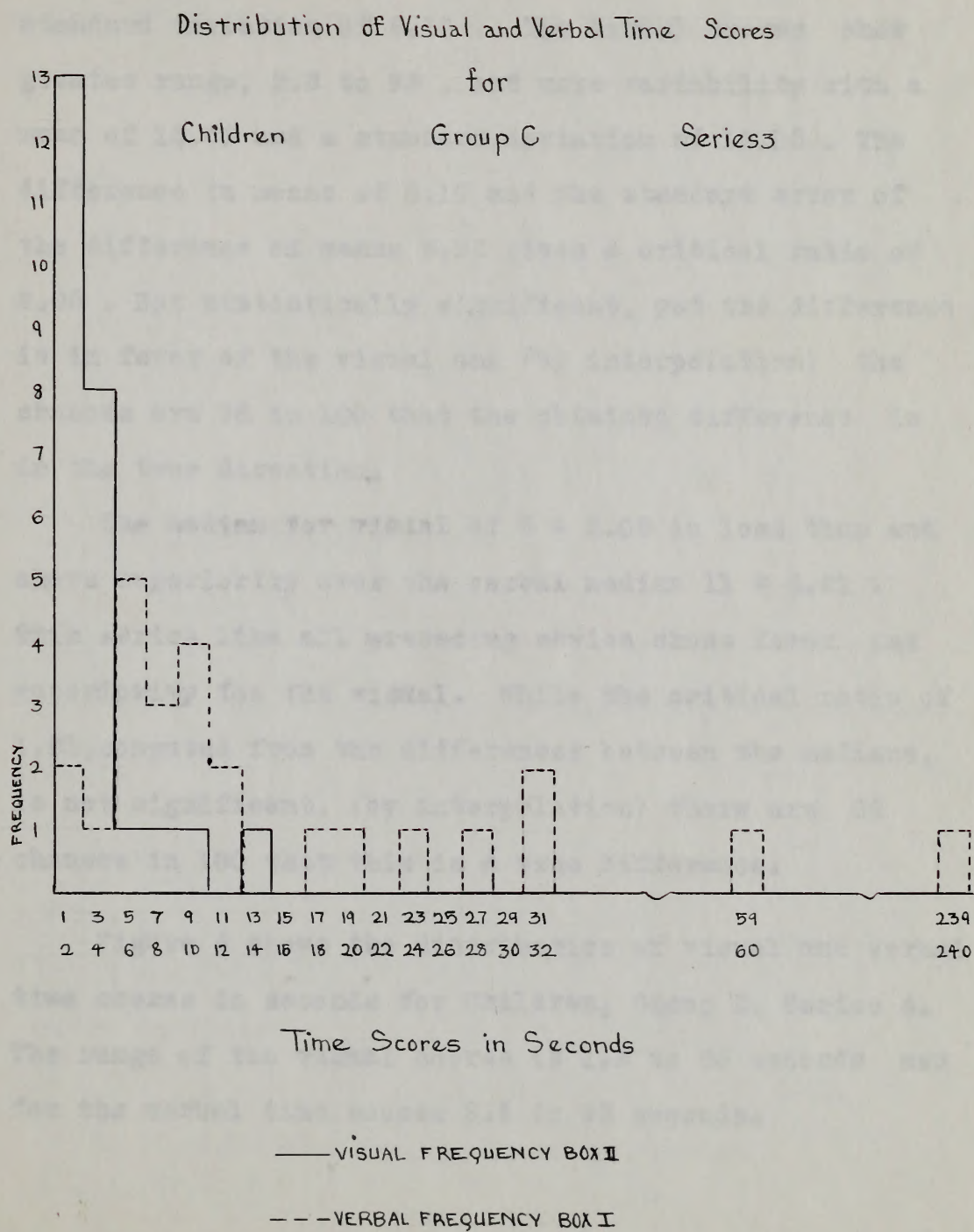






Table IV shows visual and verbal search time in seconds for Children, Group D, Series 4. The range of visual scores is 1.5 to 35 with a mean of 9.98 and a standard deviation of 8.10 . The verbal scores show greater range, 3.5 to 93 , and more variability with a mean of 18.08 and a standard deviation of 18.05 . The difference in means of 8.10 and the standard error of the difference of means 3.96 gives a critical ratio of 2.05 . Not statistically significant, yet the difference is in favor of the visual and (by interpolation) the chances are 98 in 100 that the obtained difference is in the true direction.

The median for visual of  $5 \pm 2.03$  is less than and shows superiority over the verbal median  $11 \pm 4.51$  . This series like all preceding series shows favor and superiority for the visual. While the critical ratio of 1.21, computed from the differences between the medians, is not significant, (by interpolation) there are 88 chances in 100 that this is a true difference.

Figure 4 shows the distribution of visual and verbal time scores in seconds for Children, Group D, Series 4. The range of the visual scores is 1.5 to 35 seconds and for the verbal time scores 3.5 to 93 seconds.

Table IV shows visual and verbal search time in seconds for children, Group D, Series 4. The range of visual scores is 1.5 to 35 with a mean of 8.93 and a standard deviation of 8.10. The verbal scores show a greater range, 2.5 to 93, and more variability with a mean of 18.08 and a standard deviation of 13.05. The difference in means of 8.10 and the standard error of the difference of means 8.93 gives a critical ratio of 2.05. Not statistically significant, yet the difference is in favor of the visual and (by interpolation) the chances are 38 in 100 that the obtained difference is in the true direction.

The median for visual of 5 + 8.05 is less than and shows superiority over the verbal median 11 + 4.51. This series like all preceding series shows favor and superiority for the visual. While the critical ratio of 1.21, computed from the difference between the medians, is not significant, (by interpolation) there are 38 chances in 100 that this is a true difference.

Figure 4 shows the distribution of visual and verbal time scores in seconds for children, Group D, Series 4. The range of the visual scores is 1.5 to 35 seconds and for the verbal time scores 2.5 to 93 seconds.



Table IV Shows Time Scores in Seconds for  
Children Group D Series 4.

Subjects	Visual Instruction Box II	Verbal Instruction Box I
1	2	10
2	13	8
3	10	11
4	4	8
5	1.5	5.5
6	11	7
7	21	11
8	35	19
9	4	9
10	2.5	14
11	2.5	20
12	22	17
13	27	6
14	3.5	22
15	11	30
16	23	25
17	3	25
18	1.5	3.5
19	5	6
20	4	30
21	11	17
22	4	93
23	2	7
24	15	6
25	8	42
N	25	25
Range	1.5---35	3.5---93
Mean	9.98	18.08
S.D. dis	8.10	18.05
S.E. m	1.62	3.61
Diff. of means		8.10
S.E. D.m		3.96
Critical Ratio		2.05
First Quartile	15	25
Median	5	11
Third Quartile	3	7
Q	6	9
S.E. mdn	2.03	4.51
Diff. of medians		6.
S.E. D.mdn		4.95
Critical Ratio		1.21

Table IV Shows Time Scores in Seconds for

Children

Group D

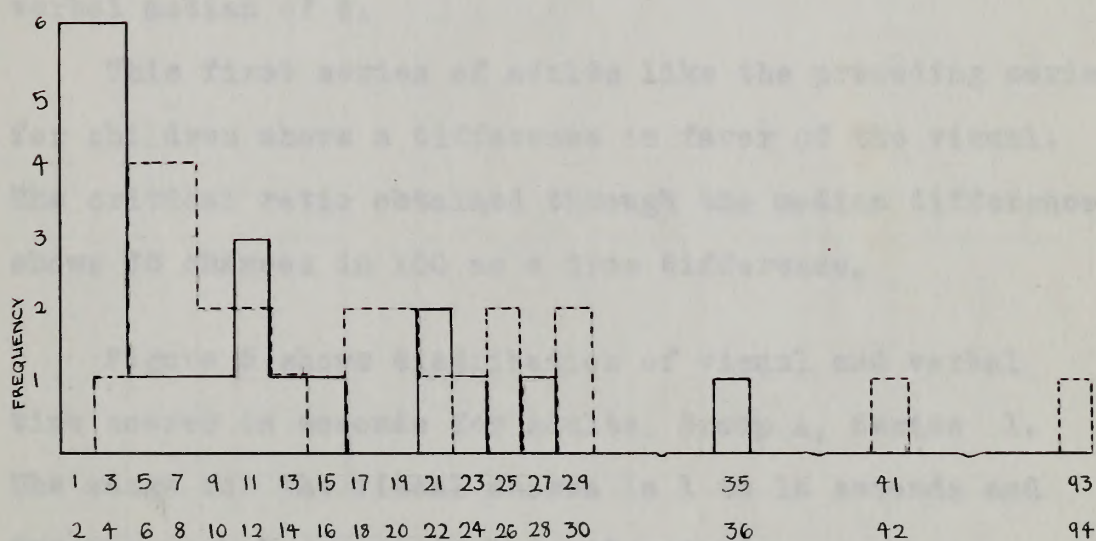
Series A.

Subjects	Box II	Box I
1	2	10
2	13	8
3	10	11
4	4	8
5	1.5	5.5
6	11	7
7	21	11
8	25	13
9	4	9
10	2.5	14
11	2.5	20
12	23	17
13	27	8
14	2.5	23
15	11	30
16	23	25
17	3	25
18	1.5	5.5
19	5	6
20	4	20
21	11	14
22	4	22
23	2	7
24	18	5
25	8	4
26	25	25
Mean	1.5	3.5
Mean	9.95	13.08
S.E. of mean	0.10	1.05
S.E. of ratio	1.52	3.51
Diff. of means		8.10
S.E. of ratio		3.95
Critical Ratio		3.05
First Quartile	12	21
Median	8	11
Third Quartile	8	7
4	8	9
S.E. of ratio	3.05	4.51
Diff. of medians		8
S.E. of ratio		4.95
Critical Ratio		1.81



Figure 4

Distribution of Visual and Verbal Time Scores.

for  
Children Group D Series 4

Time Scores in Seconds

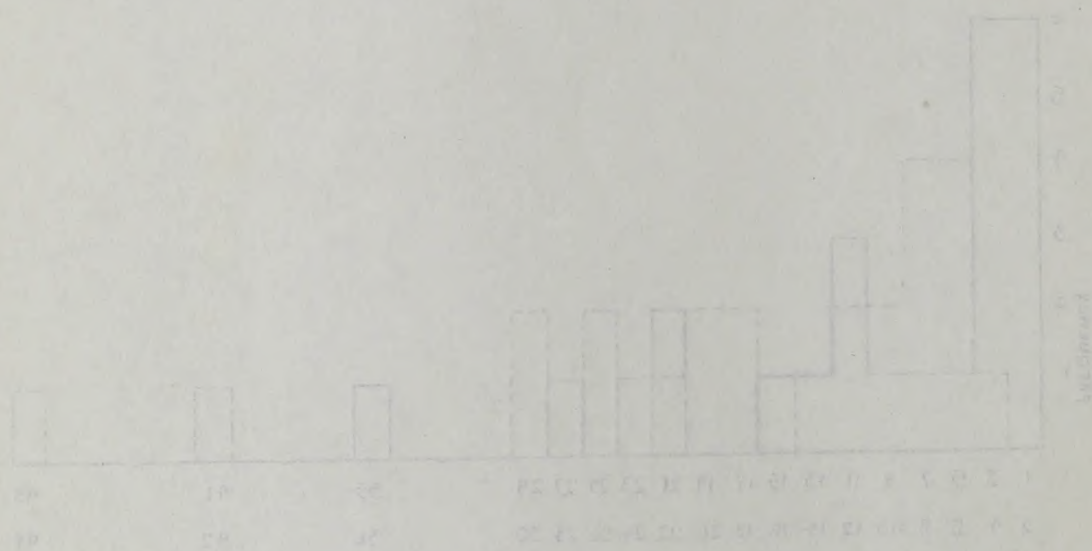
—— VISUAL FREQUENCY BOX II

---- VERBAL FREQUENCY BOX I

Figure 4

Distribution of Visual and Verbal Time Scores

Children  
Group 1  
Group 2



Time Score in Seconds

Visual Memory Group

Verbal Memory Group



Table V shows visual and verbal time scores in seconds for Adults, Group A , Series 1. The visual scores range from 1 to 15 seconds with a mean of 4.62 ,and the verbal scores range from 1 to 48 seconds with a mean of 10.96 . The visual scores show less variability with a standard deviation of 3.82 than the verbal scores with a standard deviation of 12.24 . The difference in means shows a superiority of 6.34 points in favor of the visual. The critical ratio of 2.44 approaches significance in favor of the visual with 99.2 chances in 100 that this is a true difference/.

The visual median of 4 is superior by 2 points to the verbal median of 6.

This first series of adults like the preceding series for children shows a difference in favor of the visual. The critical ratio obtained through the median difference shows 73 chances in 100 as a true difference.

Figure 5 shows distribution of visual and verbal time scores in seconds for Adults, Group A, Series 1. The range for the visual scores is 1 to 15 seconds and for the verbal scores is 1 to 48 seconds.

Table V shows visual and verbal time scores in seconds for Adults, Group A, Series I. The visual scores range from 1 to 15 seconds with a mean of 8.58, and the verbal scores range from 1 to 45 seconds with a mean of 10.98. The visual scores show less variability with a standard deviation of 3.82 than the verbal scores with a standard deviation of 12.54. The difference in means shows a superiority of 2.46 points in favor of the visual. The critical ratio of 2.44 indicates significance in favor of the visual with 99.2 chances in 100 that this is a true difference.

The visual median of 4 is superior by 3 points to the verbal median of 1.

This first series of adults like the preceding series for children shows a difference in favor of the visual. The critical ratio obtained through the median difference shows 73 chances in 100 as a true difference.

Figure 3 shows distribution of visual and verbal time scores in seconds for Adults, Group A, Series I. The range for the visual scores is 1 to 15 seconds and for the verbal scores is 1 to 45 seconds.



Table V Shows Time Scores in Seconds for  
Adults                      Group A                      Series 1.

Subjects	Visual Instruction	Verbal Instruction
	Box I	Box II
1	4	6
2	5	4
3	5	41
4	2	29
5	15	5
6	1	7
7	4	2
8	4	15
9	2	3
10	2	12
11	4	7
12	3	29
13	3	14
14	4	1
15	10	3.5
16	2.5	2.5
17	4.5	12
18	2.5	3.5
19	3.5	6.5
20	5	6
21	4.5	4
22	15	48
23	6	2.5
24	2.5	8
25	1.5	2.5
N	25	25
Range	1----15	1----48
Mean	4.62	10.96
S.D. dis	3.82	12.24
S.E. m	.76	2.45
Diff. of Means		6.34
S.E.D.m		2.6
Critical Ratio		2.44
First Quartile	5	14
Median	4	6
Third Quartile	2.5	3.5
Q	1.25	5
S.E. mdn	.95	3.06
Diff. of medians		2.
S.E.D.mdn		3.20
Critical Ratio		.63





Figure 5

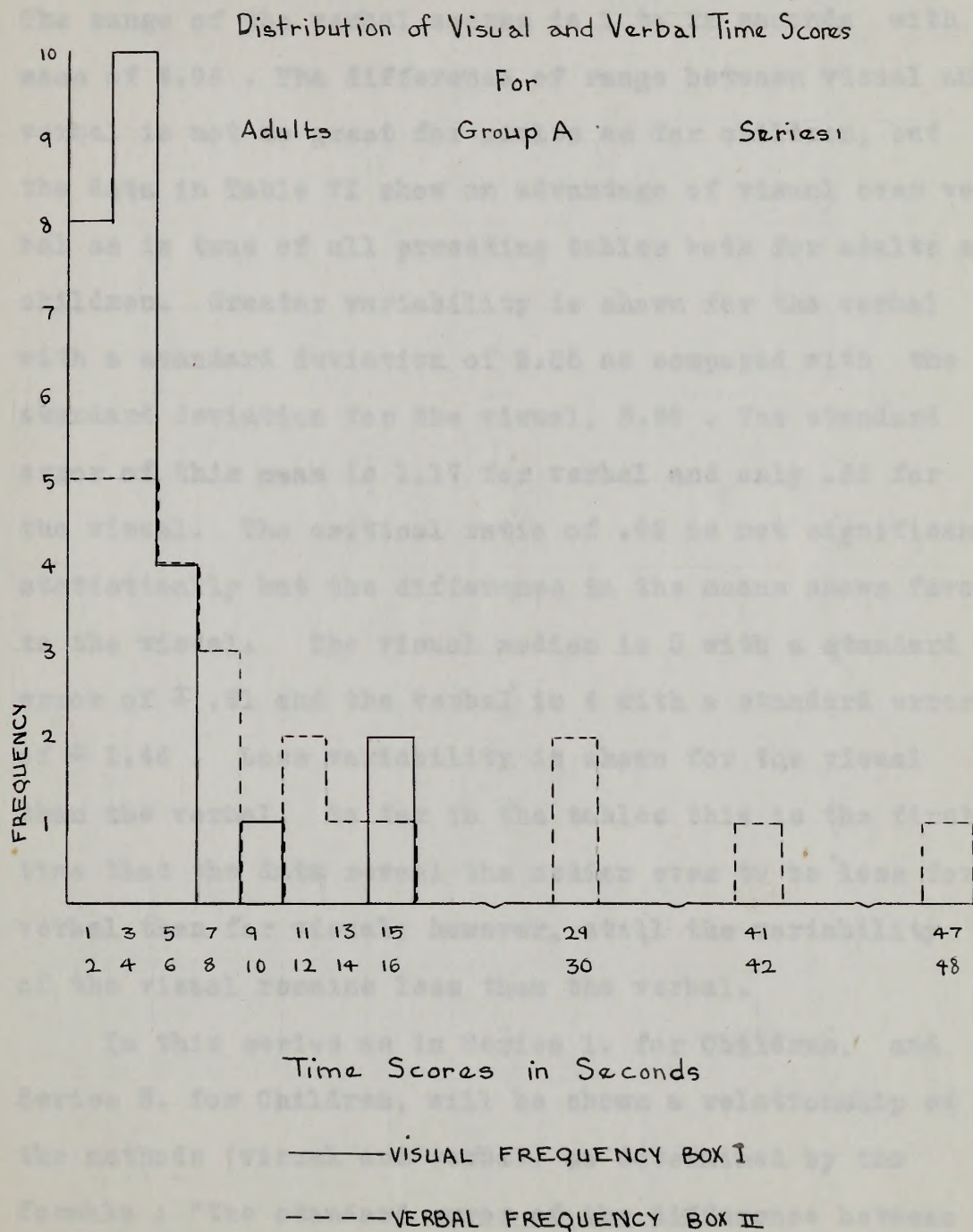
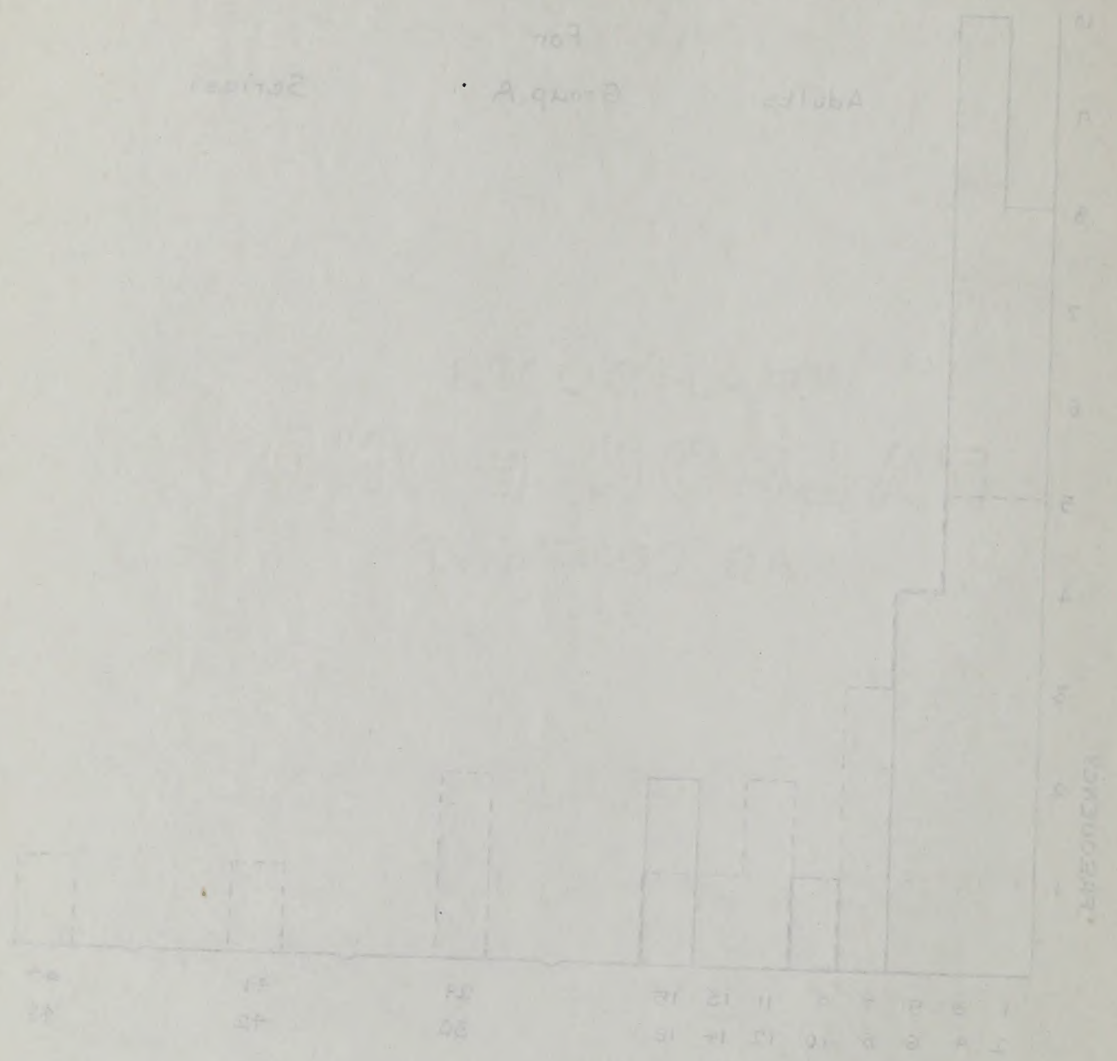


Figure 2

Distribution of Visual and Verbal Time Scores

For

Adults Group A Series



Time Scores in Seconds

Visual Frequency Box I

Verbal Frequency Box II



Table VI shows the visual and verbal time scores in seconds for Adults, Group B, Series 2. The range of the visual scores is 1.5 to 15 seconds with a mean of 5.76 . The range of the verbal scores is 1 to 22 seconds with a mean of 6.96 . The difference of range between visual and verbal is not so great for adults as for children, but the data in Table VI show an advantage of visual over verbal as is true of all preceding tables both for adults and children. Greater variability is shown for the verbal with a standard deviation of 5.85 as compared with the standard deviation for the visual, 3.25 . The standard error of this mean is 1.17 for verbal and only .65 for the visual. The critical ratio of .99 is not significant statistically but the difference in the means shows favor to the visual. The visual median is 5 with a standard error of  $\pm .81$  and the verbal is 4 with a standard error of  $\pm 1.46$  . Less variability is shown for the visual than the verbal. So far in the tables this is the first time that the data reveal the median ever to be less for verbal than for visual; however, still the variability of the visual remains less than the verbal.

In this series as in Series 1. for Children, and Series 3. for Children, will be shown a relationship of the methods (visual and verbal) as determined by the formula : "the standard error of the difference between

Table VI shows the visual and verbal time scores in seconds for Adults, Young B. Children, and the range of the visual scores is 1.5 to 2.5 seconds with a mean of 1.75. The range of the verbal scores is 1 to 2 seconds with a mean of 1.5. The difference of range between visual and verbal is not as great for adults as for children, but the data in Table VI show an advantage of visual over verbal as in tests of all preceding tables both for adults and children. Greater variability is shown for the verbal with a standard deviation of 0.25 as compared with the standard deviation for the visual, 0.22. The standard error of this mean is 0.17 for verbal and only .05 for the visual. The critical ratio of .95 is not significant statistically but the difference in the means shows favor to the visual. The visual median is 1 with a standard error of 0.21 and the verbal is 1 with a standard error of 0.25. Less variability is shown for the visual than the verbal. So far in the tables this is the first time that the data reveal the median over to be less for verbal than for visual; however, still the variability of the visual remains less than the verbal. In this series as in Series I, for Children, and Series II, for Children, will be shown a relationship of the methods (visual and verbal) as determined by the formula: "The standard error of the difference between



Table VI Shows Time Scores in Seconds for

Adults	Group B	Series 2.
Subjects	Verbal Instruction Box II	Visual Instruction Box I
1	2	5
2	11	4.5
3	16	4
4	17	7
5	3	5
6	4	5
7	3.5	9
8	15	4
9	11	4
10	2	13
11	2	12
12	22	5
13	3	5
14	1	7
15	12	7
16	1	5
17	2.5	1.5
18	1	5
19	12	5
20	3	3
21	7	2
22	5	3
23	4	15
24	4	3
25	10	5
N	25	25
Range	1---22	1.5---15
Mean	6.96	5.76
S.D. dis	5.85	3.25
S.E. <sub>m</sub>	1.17	.65
Diff. of means		1.20
S.E. <sub>D.M.</sub>		1.31
Critical Ratio		.99
First Quartile	12	7
Median	4	5
Third Quartile	3	4
Q	5	1.5
S.E. <sub>mdn</sub>	1.46	.81
Diff. of medians		1.0
S.E. <sub>D.mdn</sub>		1.65
Critical Ratio		.61

Table VI Shows Time Scores in Seconds for

Subjects		Group B		Series A	
Visual Inspection		Visual Inspection		Visual Inspection	
Box II		Box II		Box I	
1	2	1	2	1	2
2	11	2	11	2	4.6
3	12	3	12	3	4
4	17	4	17	4	7
5	3	5	3	5	3
6	4	6	4	6	3
7	3.8	7	3.8	7	3
8	15	8	15	8	4
9	11	9	11	9	13
10	2	10	2	10	12
11	2	11	2	11	12
12	22	12	22	12	12
13	3	13	3	13	7
14	1	14	1	14	7
15	12	15	12	15	12
16	1	16	1	16	1.5
17	2.5	17	2.5	17	1.5
18	1	18	1	18	12
19	12	19	12	19	12
20	2	20	2	20	12
21	7	21	7	21	12
22	2	22	2	22	12
23	4	23	4	23	12
24	4	24	4	24	3
25	10	25	10	25	3
26	22	26	22	26	12
Range	1--22	Range	1--22	Range	1.5--12
Mean	8.95	Mean	8.95	Mean	8.75
S.D. 0.15	0.15	S.D. 0.15	0.15	S.D. 0.15	0.15
S.E. 0.04	0.04	S.E. 0.04	0.04	S.E. 0.04	0.04
Diff. of means		Diff. of means		Diff. of means	
S.E. 0.04	1.31	S.E. 0.04	1.31	S.E. 0.04	1.31
Critical Ratio	0.99	Critical Ratio	0.99	Critical Ratio	0.99
First Quartile	12	First Quartile	12	First Quartile	7
Median	4	Median	4	Median	4
Third Quartile	3	Third Quartile	3	Third Quartile	4
S.E. 0.04	1.48	S.E. 0.04	1.48	S.E. 0.04	1.48
Diff. of means		Diff. of means		Diff. of means	
S.E. 0.04	1.31	S.E. 0.04	1.31	S.E. 0.04	1.31
Critical Ratio	0.99	Critical Ratio	0.99	Critical Ratio	0.99



correlated medians." By the rank difference Method

$$\begin{aligned} \sigma_{\text{Diff. mdn}} &= \sqrt{(1.46)^2 + (.81)^2 - 2(-.18)(1.46)(.81)} \\ &= 1.79 \end{aligned}$$

Median difference = 1.0

$$\text{Critical Ratio} = \frac{1.0}{1.79} = .56$$

The correlation does not materially affect the critical ratio .59 as compared to the critical ratio of .61 as computed from the differences between the uncorrelated medians. The difference is not statistically significant but the data reveal the difference to favor the visual scores.

Figure 6 shows the distribution of visual and verbal time scores in seconds for Adults, Group B, Series 2. The range of the visual scores is 1.5 to 15 seconds and 1 to 22 seconds for the verbal scores.

correlated median." By the rank difference method

$$\sigma_{\text{diff. med.}} = \sqrt{(1.44)^2 \cdot \frac{1}{2} + (-.81)^2 - 2(-.18)(.74)(.81)} = 1.18$$

$$= 1.79$$

$$\text{Median difference} = 1.0$$

$$\text{Critical Ratio} = \frac{1.0}{1.79} = .56$$

The correlation does not materially affect the critical ratio. It is compared to the critical ratio of .61 as computed from the difference between the uncorrelated medians. The difference is not statistically significant but the data reveal the difference to favor the visual scores.

Figure 6 shows the distribution of visual and verbal time scores in seconds for Adults, Group B, Series 2. The range of the visual scores is 1.5 to 15 seconds and 1 to 22 seconds for the verbal scores.



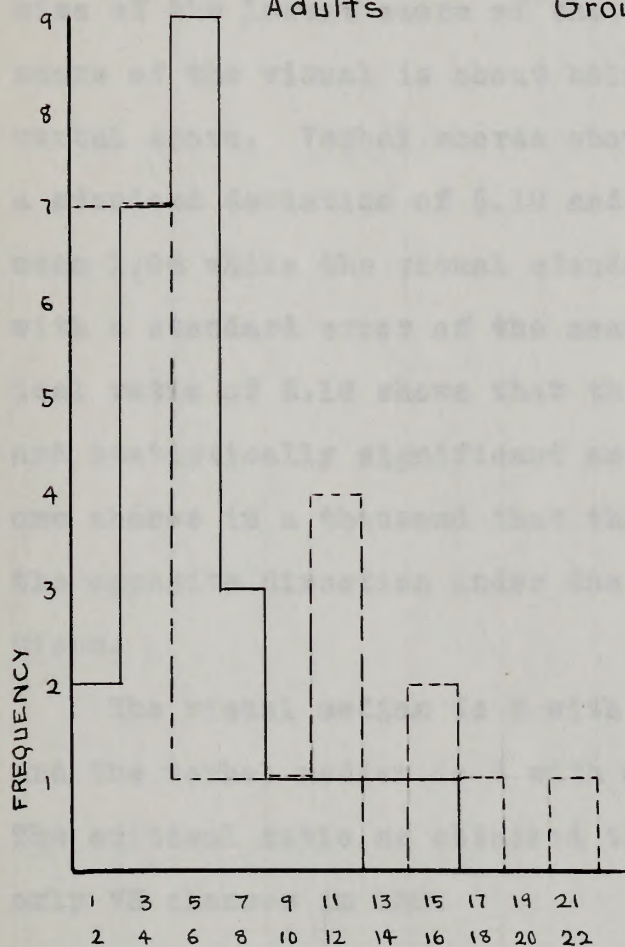
Figure 6

Distribution of Visual and Verbal Time Scores  
for

Adults

Group B

Series 2



Time Scores in Seconds

—— VISUAL FREQUENCY BOX I

----- VERBAL FREQUENCY BOX II





Table VII shows the visual and verbal time scores in seconds for Adults, Group C, Series 3. The visual scores range from 1.5 to 11 seconds with a mean of 3.4 , and the verbal scores range from 2.5 to 23 seconds with a mean of 6.92 . The lowest score for the visual is almost half the size of the lowest score of the verbal, and the highest score of the visual is about half the size of the highest verbal score. Verbal scores show greater variability with a standard deviation of 5.18 and the standard error of the mean 1.04 while the visual standard deviation is only 1.99 with a standard error of the mean of only .40 . The critical ratio of 3.18 shows that the difference is reliable and statistically significant and means that there is only one chance in a thousand that the difference might be in the opposite direction under the same experimental conditions.

The visual median is 3 with a standard error of  $\pm .50$  and the verbal median is 4 with a standard error of  $\pm 1.30$  . The critical ratio as obtained through the medians shows only 73 chances in 100.

Table VII like all preceding tables for children and adults shows favor toward the visual.

Figure 7 shows the distribution of visual and verbal time scores in seconds for Adults, Group C, Series 3. The range of the visual scores is 1.5 to 11 and the range of the verbal scores is 2.5 to 23 .

Table VII shows the visual and verbal time scores in seconds for Adults, Group 5, Series 3. The visual scores range from 1.5 to 11 seconds with a mean of 3.4, and the verbal scores range from 2.5 to 25 seconds with a mean of 8.98. The lowest score for the visual is almost half the size of the lowest score of the verbal, and the highest score of the visual is about half the size of the highest verbal score. Verbal scores show greater variability with a standard deviation of 5.18 and the standard error of the mean 1.04 while the visual standard deviation is only 1.92 with a standard error of the mean of only .40. The critical ratio of 3.18 shows that the difference is reliable and statistically significant and means that there is only one chance in a thousand that the difference might be in the opposite direction under the same experimental conditions.

The visual median is 3 with a standard error of 1.50 and the verbal median is 4 with a standard error of 1.30. The critical ratio as obtained through the medians shows only 78 chances in 100.

Table VII like all preceding tables for children and adults shows favor toward the visual.

Figure 7 shows the distribution of visual and verbal time scores in seconds for Adults, Group 5, Series 3. The range of the visual scores is 1.5 to 11 and the range of the verbal scores is 2.5 to 25.



Table VII Shows Time Scores in Seconds for

Adults

Group C

Series 3.

Subjects	Verbal Instruction Box I	Visual Instruction Box II
1	7.5	1.5
2	4	2
3	4	3
4	2.5	3.5
5	3	2
6	3.5	2.5
7	5.5	5
8	6.5	3.5
9	16.5	2.5
10	4	2
11	7	3.5
12	2.5	3
13	3	6
14	7.5	4
15	11	1.5
16	12	11
17	3	2.5
18	4	4
19	2.5	2.5
20	4	2.5
21	3.5	2.5
22	5	6
23	15	2
24	23	3.5
25	13	3
N	25	25
Range	2.5---23	1.5---11
Mean	6.92	3.4
S.D. dis	5.18	1.99
S.E. m	1.04	.40
Diff. of means		3.52
S.E. D.m		1.11
Critical Ratio		3.18
First Quartile	11	4
Median	4	3
Third Quartile	3.5	2.5
Q	4	.75
S.E. mdn	1.30	.50
Diff. of medians		1.0
S.E. D.mdn		1.39
Critical Ratio		.72

Table VII Shows Time Scores in Seconds for  
Adults Group 2 Series 3.

Subjects	Box I	Box II
1	1.5	1.5
2	4	2
3	4	2
4	10.5	2.5
5	8	2
6	8.5	2.5
7	8.5	2
8	8.5	2.5
9	10.5	2.5
10	4	2
11	7	2.5
12	2.5	2
13	8	2
14	7.5	2
15	11	1.5
16	12	1.5
17	8	2.5
18	4	4
19	10.5	2.5
20	4	2.5
21	8.5	2.5
22	8	2.5
23	12	2
24	12	2
25	12	2
<hr/>		
Range	2.5--12	1.5--11
Mean	6.92	2.4
S.D.	6.18	1.92
S.E.	1.04	.40
<hr/>		
Diff. of means	1.5	1.5
S.E.D.M.	1.11	1.11
Critical Ratio	2.18	2.18
<hr/>		
First Quartile	11	2
Median	4	2
Third Quartile	8.5	2.5
Q	4	2.5
S.E. median	1.30	.75
<hr/>		
Diff. of medians	9	9
S.E.D.M.	1.39	1.39
Critical Ratio	.75	.75



Figure 7

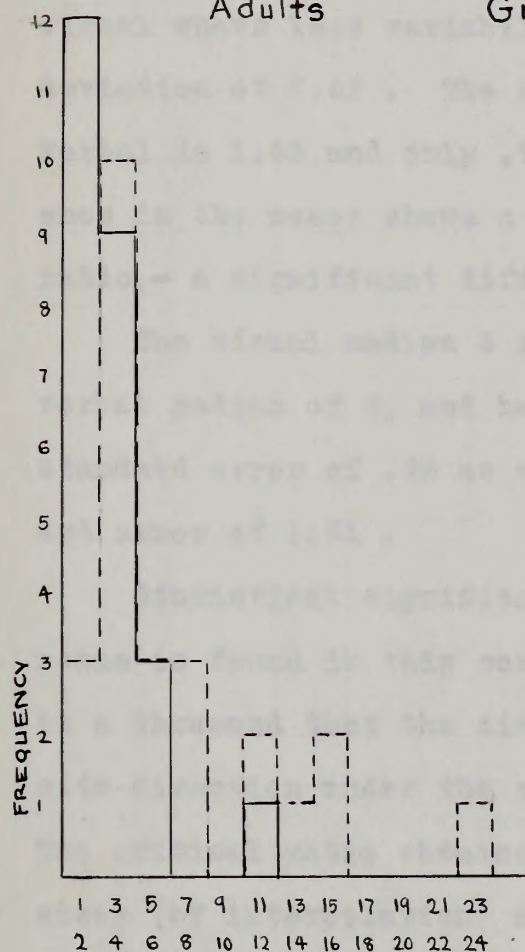
## Distribution of Visual and Verbal Time Scores

for

Adults

Group C

Series 3



Time Scores in Seconds

—— VISUAL FREQUENCY BOX II

---- VERBAL FREQUENCY BOX I





Table VIII shows the visual and verbal time scores in seconds for Adults, Group D, Series 4. The visual scores range from 2 to 15 seconds with a mean of 4.6 . The verbal scores range from 2 to 35 seconds with a mean of 10.44 . The standard deviation of 3.71 for visual shows less variability than the verbal standard deviation of 7.63 . The standard error of the mean for verbal is 1.53 and only .74 for the visual. The difference in the means shows a reliability of 3.44 critical ratio,-- a significant difference .

The visual median 3 is less by 5 points than the verbal median of 8, and has a correspondingly lower standard error of .93 as compared to the verbal standard error of 1.91 .

Statistical significance for the difference in the means is found in this series. There is only one chance in a thousand that the difference might be in the opposite direction under the same experimental conditions. The critical ratio obtained through the median differences (by interpolation) shows 99 chances in 100 that this is a true difference.

Figure 8 shows the distribution of visual and verbal time scores for Adults, Group D, Series 4. The range for the visual scores is 2 to 15 and the range for the verbal scores is 2 to 35 .

Table VII shows the visual and verbal time scores in seconds for Adults, Group B, Series A. The visual scores range from 8 to 15 seconds with a mean of 10.4. The verbal scores range from 8 to 35 seconds with a mean of 10.4. The standard deviation of 3.71 for visual shows less variability than the verbal standard deviation of 7.33. The standard error of the mean for verbal is 1.53 and only .14 for the visual. The difference in the means shows a reliability of 3.44 critical ratio, - a significant difference.

The visual median is less by 5 points than the verbal median of 8, and has a correspondingly lower standard error of .33 as compared to the verbal standard error of 1.31.

Statistical significance for the difference in the means is found in this series. There is only one chance in a thousand that the difference might be in the opposite direction under the same experimental conditions. The critical ratio obtained through the median difference (by interpolation) shows 32 chances in 100 that this is a true difference.

Figure 8 shows the distribution of visual and verbal time scores for Adults, Group B, Series A. The range for the visual scores is 8 to 15 and the range for the verbal scores is 8 to 35.



Table VIII Shows Time Scores in Seconds for

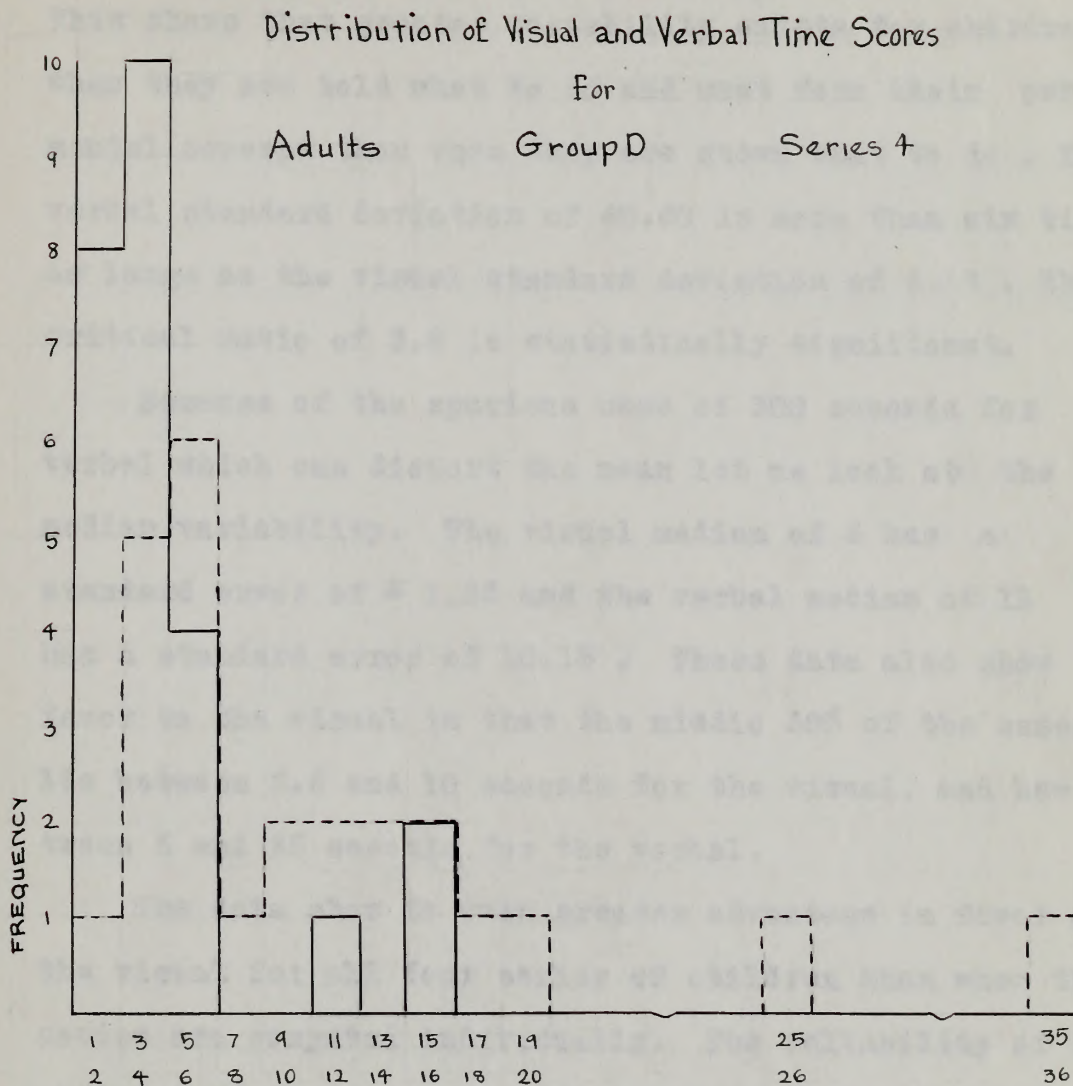
Adults	Group D	Series 4.
Subjects	Visual Instruction Box II	Verbal Instruction Box I
1	4	6
2	15	13
3	12	35
4	6	6
5	3	4.5
6	4	9
7	3	4
8	3.5	13
9	6	12
10	2	4
11	4	2
12	2	4
13	3	5
14	3	5
15	2	10
16	2	6
17	2	20
18	2.5	16
19	2	25
20	3	17
21	3.5	15
22	5	8
23	2.5	12.5
24	5	4
25	15	5
N	25	25
Range	2-----15	2-----35
Mean	4.6	10.44
S.D. dis	3.71	7.63
S.E. m	.74	1.53
Diff. of means		5.84
S.E.D.m		1.70
Critical Ratio		3.44
First Quartile	5	15
Median	3	8
Third Quartile	2.5	5
Q	1.25	5
S.E. mdn	.93	1.91
Diff. of medians		5.0
S.E.D.mdn		2.12
Critical Ratio		2.31

Table VIII Shows Time Scores in Seconds for

Adults		Group D		Series A	
Subjects		Box II		Box I	
1	1	1	1	1	1
2	2	12	12	12	12
3	3	12	12	12	12
4	4	3	3	3	3
5	5	3	3	3	3
6	6	4	4	4	4
7	7	5	5	5	5
8	8	8.5	8.5	12	12
9	9	6	6	12	12
10	10	3	3	4	4
11	11	4	4	8	8
12	12	3	3	4	4
13	13	3	3	3	3
14	14	3	3	2	2
15	15	3	3	10	10
16	16	3	3	8	8
17	17	3	3	20	20
18	18	2.5	2.5	12	12
19	19	3	3	25	25
20	20	3	3	17	17
21	21	3.5	3.5	18	18
22	22	3	3	9	9
23	23	3.5	3.5	12.5	12.5
24	24	3	3	4	4
25	25	12	12	3	3
Range		2---12		2---25	
Mean		4.5		10.44	
S.D. (s)		3.71		7.82	
S.E. (m)		.74		1.82	
Diff. of means		3.84		3.84	
S.E.D. (m)		1.70		1.70	
Critical Ratio		2.44		2.44	
First Quartile		3		12	
Median		3		8	
Third Quartile		3.5		8	
S.E. (m)		1.92		1.92	
Diff. of medians		3.0		3.0	
S.E.D. (m)		2.12		2.12	
Critical Ratio		2.81		2.81	



Figure 8



Time Scores in Seconds

—— VISUAL FREQUENCY BOX II

--- VERBAL FREQUENCY BOX I





Table IX shows a comparison of all visual scores and all verbal scores for Children. The range of visual scores is 0.5 to 35 ; the range of verbal scores from 0.5 to 300. This shows that greater variability exists for children when they are told what to do and must form their own mental concept than when they are shown what to do . The verbal standard deviation of 40.60 is more than six times as large as the visual standard deviation of 6.17 . The critical ratio of 3.9 is statistically significant.

Because of the spurious case of 300 seconds for verbal which can distort the mean let us look at the median variability. The visual median of 4 has a standard error of  $\pm 1.55$  and the verbal median of 11 has a standard error of 10.15 . These data also show favor to the visual in that the middle 50% of the cases lie between 2.5 and 10 seconds for the visual, and between 6 and 25 seconds for the verbal.

The data show to even greater advantage in favor of the visual for all four series of children than when the series are computed individually. The reliability of the median difference does not show statistical significance but the data reveal that there are about 75 chances in 100 that it is a true difference.

Figure 9 shows distribution of visual and verbal time scores in seconds for children for all four series. The range for the visual is 0.5 to 35 seconds and for the verbal is 0.5 to 300 seconds.



Table IX shows a comparison of all visual scores and all verbal scores for children. The range of visual scores is 0.5 to 35; the range of verbal scores from 0.5 to 300. This shows that greater variability exists for children when they are told what to do and must form their own mental concept than when they are shown what to do. The verbal standard deviation of 40.53 is more than six times as large as the visual standard deviation of 6.14. The critical ratio of 8.8 is statistically significant.

Because of the extreme case of 300 seconds for verbal which can distort the mean let us look at the median variability. The visual median of 4 has a standard error of  $\pm 1.55$  and the verbal median of 11 has a standard error of 10.13. These data also show favor to the visual in that the middle 50% of the cases lie between 2.5 and 10 seconds for the visual, and between 6 and 22 seconds for the verbal.

The data show to even greater advantage in favor of the visual for all four series of children than when the series are computed individually. The reliability of the median difference does not show statistical significance but the data reveal that there are about 75 chances in 100 that it is a true difference.

Figure 2 shows distribution of visual and verbal time scores in seconds for children for all four series. The range for the visual is 0.5 to 35 seconds and for the verbal is 0.5 to 300 seconds.



Table IX Shows a Comparison of  
Visual and Verbal Instruction Scores  
with all Four Series for Children

Series	1-2-3-4	1-2-3-4
Children	Visual Instruction	Verbal Instruction
N	100	100
Range	0.5---35	0.5---300
Mean	7.29	24.23
S.D. dis	6.17	40.60
S.E. m	1.24	8.12
Diff. of means		16.94
S.E. D.m		4.35
Critical Ratio		3.9
First Quartile	10	25
Median	4	11
Third Quartile	2.5	6
Q	3.75	9.5
S.E. mdn	1.55	10.15
Diff. of medians		7.0
S.E. D.mdn		10.22
Critical Ratio		.69

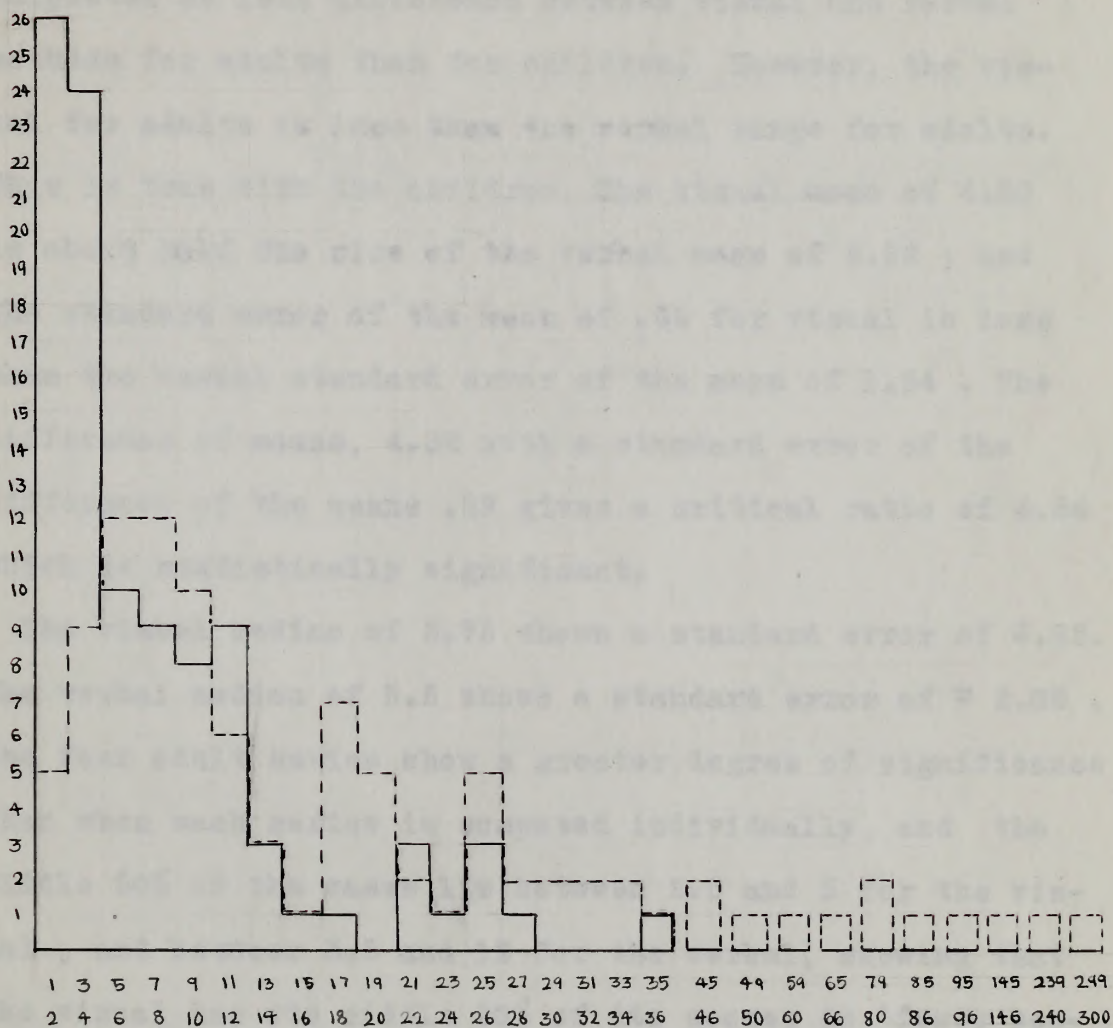
Table IX shows a comparison of  
Visual and Verbal Instruction Scores  
with all four series for children

Series		Children		Visual Instruction Verbal Instruction	
I-S-E-A		I-S-E-A		I-S-E-A	
		N		100	
		Range		0.5-35	
		Mean		7.89	
		S.D. Std		6.17	
		S.E.		1.24	
		Diff. of means		16.64	
		S.E.		4.36	
		Critical Ratio		3.9	
		First Quartile		10	
		Median		4	
		Third Quartile		8.5	
		Q		8.78	
		S.E.		1.55	
		Mean		10.15	
		Diff. of means		7.0	
		S.E.		10.32	
		Critical Ratio		6.9	



Figure 9

Distribution of Visual and Verbal Time Scores  
of all four series for Children



Time Scores in Seconds

—— VISUAL FREQUENCY BOXES I & II

---- VERBAL FREQUENCY BOXES I & II





Table X shows a comparison of visual and verbal instruction scores with all four series for Adults . The range for the visual is 1 to 15 seconds and the range for the verbal is 1 to 48. Here the data is interpreted as less difference between visual and verbal methods for adults than for children. However, the visual for adults is less than the verbal range for adults. This is true with the children. The visual mean of 4.50 is about half the size of the verbal mean of 8.82 ; and the standard error of the mean of .66 for visual is less than the verbal standard error of the mean of 1.64 . The difference of means, 4.32 with a standard error of the difference of the means .89 gives a critical ratio of 4.84 which is statistically significant.

The visual median of 3.75 shows a standard error of  $\pm .83$ . The verbal median of 5.5 shows a standard error of  $\pm 2.05$  . The four adult series show a greater degree of significance than when each series is computed individually, and the middle 50% of the cases lie between 2.5 and 5 for the visual , and between 3.5 and 12 for the verbal, showing that the visual has its middle 50% of its scores in 'fewer seconds' than the verbal. More visual scores occur in the 'fewer seconds' period , and only verbal scores occur in the 'longer seconds' area.

Figure 10 shows the distribution of combined time scores for visual and verbal for all four Adult series. The range of the visual scores is 1 to 15 seconds, and for the verbal is 1 to 48 seconds.



Table I shows a comparison of visual and verbal  
 instruction scores with all four series for adults.  
 The range for the visual is 1 to 15 seconds and the  
 range for the verbal is 1 to 45. Here the data is in-  
 terpreted as less difference between visual and verbal  
 methods for adults than for children. However, the vis-  
 ual for adults is less than the verbal range for adults.  
 This is true with the children. The visual mean of 4.50  
 is about half the size of the verbal mean of 9.33; and  
 the standard error of the mean of .46 for visual is less  
 than the verbal standard error of the mean of 1.34. The  
 difference of means, 4.83 with a standard error of the  
 difference of the means, .88 gives a critical ratio of 5.44  
 which is statistically significant.

The visual median of 3.75 shows a standard error of 1.53.  
 The verbal median of 8.5 shows a standard error of 2.05.  
 The four adult series show a greater degree of significance  
 than when each series is compared individually, and the  
 middle 50% of the cases lie between 3.5 and 6 for the vis-  
 ual, and between 5.5 and 15 for the verbal, showing that  
 the visual has the middle 50% of its scores in lower sec-  
 onds than the verbal. More verbal scores occur in the  
 'lower seconds' period, and only verbal scores occur in  
 the 'longer seconds' group.

Figure 10 shows the distribution of combined time scores  
 for visual and verbal for all four adult series. The range  
 of the visual scores is 1 to 15 seconds, and for the verbal  
 is 1 to 45 seconds.



Table X Shows a Comparison of  
Visual and Verbal Instruction Scores  
with all Four Series for Adults

Series	1-2-3-4	1-2-3-4
Adults	Visual Instruction	Verbal Instruction
N	100	100
Range	1-----15	1-----48
Mean	4.50	8.82
S.D. dis	3.29	8.21
S.E. m	.66	1.64
Diff. of means		4.32
S.E. D.m		.89
Critical Ratio		4.84
First Quartile	5	12
Median	3.75	5.5
Third Quartile	2.5	3.5
Q	1.25	4.25
S.E. mdn	.83	2.05
Diff. of medians		1.75
S.E. D.mdn		2.21
Critical Ratio		.79

Table I shows a comparison of  
Visual and Verbal Instruction Series  
with all four series for Adults

Series	Visual Instruction	Verbal Instruction
1-2-3-4	1-2-3-4	1-2-3-4
N	100	100
Range	1-15	1-15
Mean	4.50	4.50
S.D. (s)	2.50	2.50
S.E.	.50	.50
<hr/>		
Diff. of means	4.50	4.50
S.E.	.50	.50
Critical Ratio	4.50	4.50
<hr/>		
First Quartile	5	5
Median	2.50	2.50
Third Quartile	2.50	2.50
Q	1.50	1.50
S.D.	.80	.80
<hr/>		
Diff. of medians	1.50	1.50
S.E.	.50	.50
Critical Ratio	.50	.50



Figure 10 shows the distribution of combined time scores for visual and verbal methods of instruction for all four adult series. The range of the visual scores is from 1 to 15 seconds, and the range for the verbal scores is from 1 to 48 seconds.

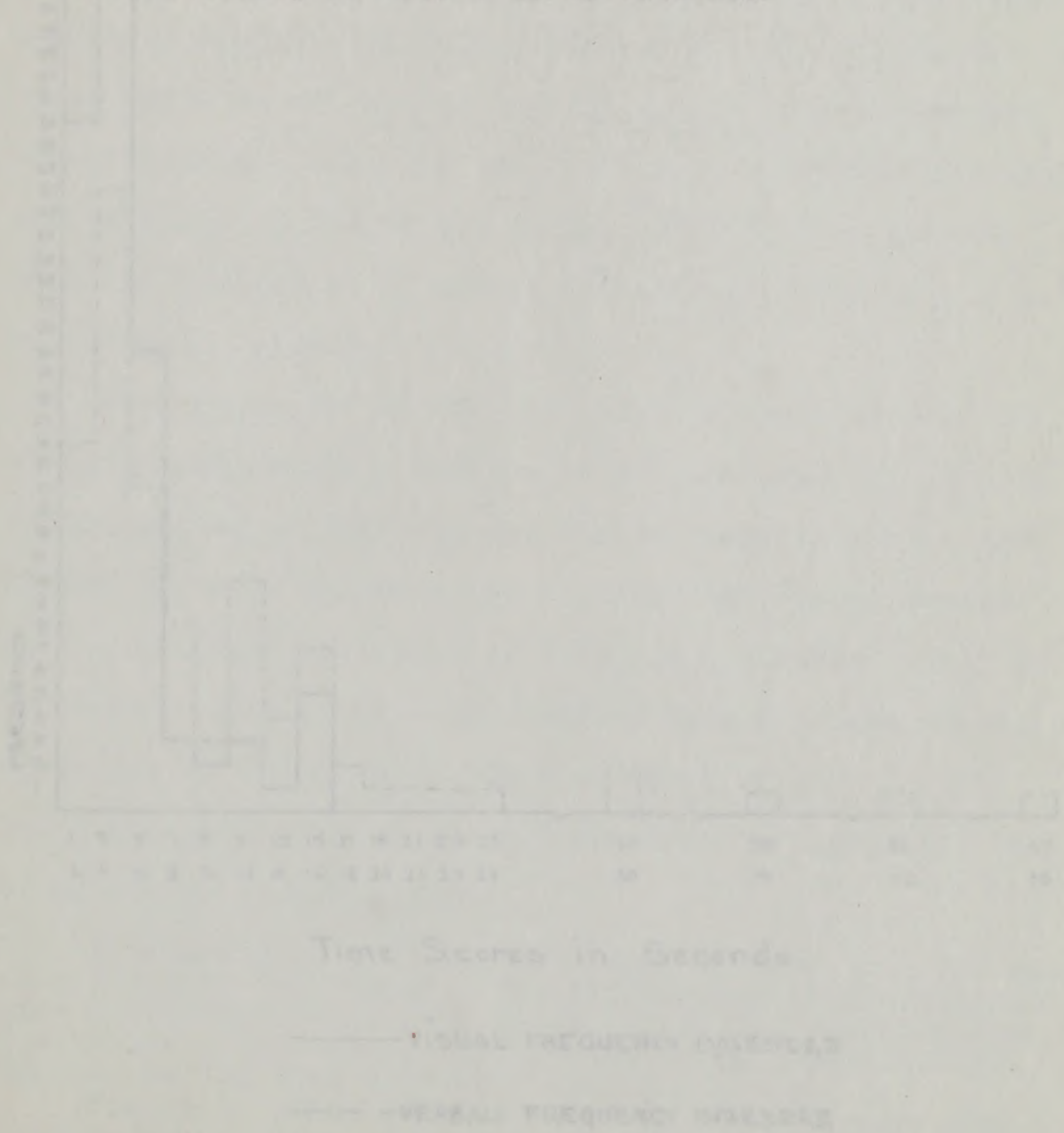
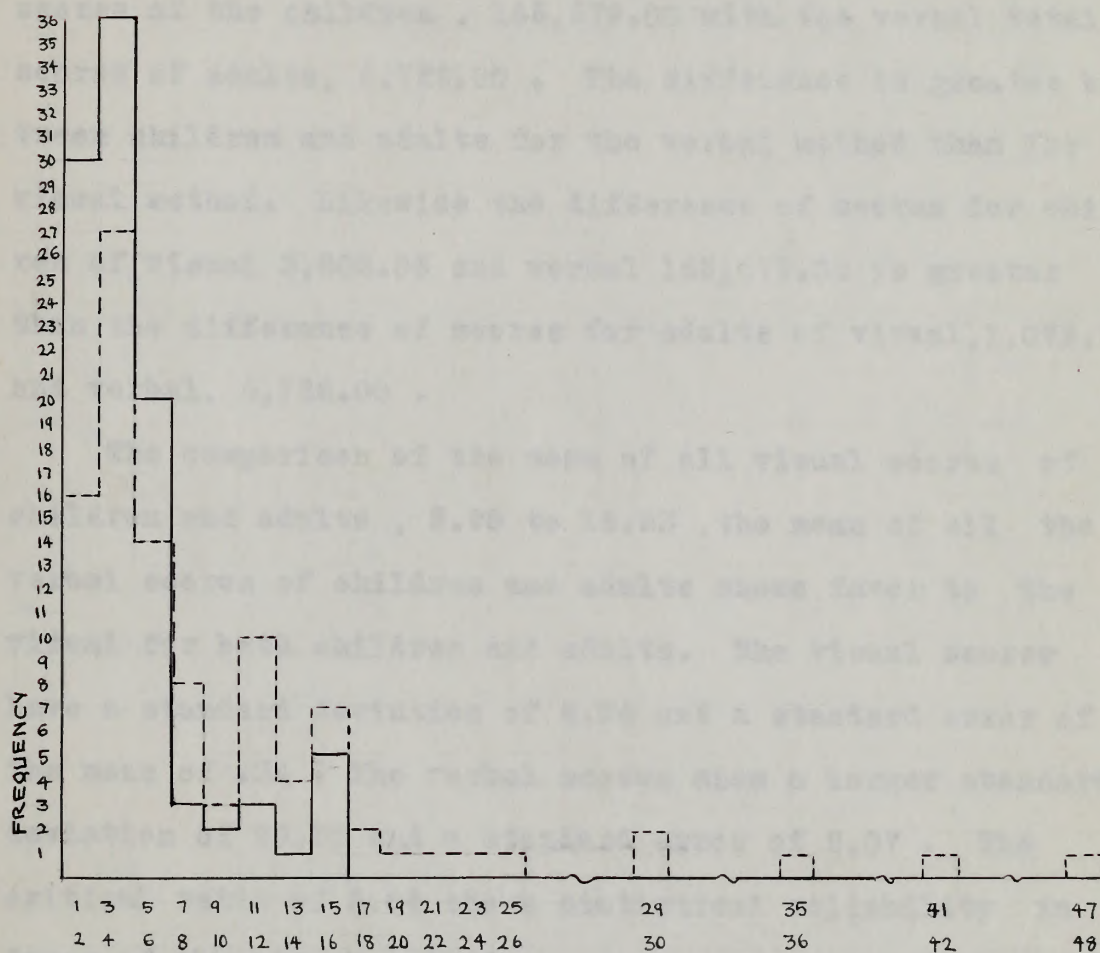






Figure 10

Distribution of Visual and Verbal Time Scores  
of all four series for Adults



Time Scores in Seconds

—— VISUAL FREQUENCY BOXES I & II

--- VERBAL FREQUENCY BOXES I & II





Table XI shows a comparison of all visual scores for Children and Adults with all verbal scores for Children and Adults. The visual total scores for children is 3,802.06 seconds compared with 1,079.25 for adults. A greater difference exists in comparing the verbal total scores of the children , 165,579.00 with the verbal total scores of adults, 6,726.00 . The difference is greater between children and adults for the verbal method than for the visual method. Likewise the difference of scores for children of visual 3,802.06 and verbal 165,579.00 is greater than the difference of scores for adults of visual 1,079.25 and verbal, 6,726.00 .

The comparison of the mean of all visual scores of children and adults , 5.98 to 16.53 , the mean of all the verbal scores of children and adults shows favor to the visual for both children and adults. The visual scores have a standard deviation of 4.94 and a standard error of the mean of .34 . The verbal scores show a larger standard deviation of 29.35 and a standard error of 2.07 . The critical ratio of 5.04 shows statistical reliability in favor of the visual method.

The median of  $4 \pm .43$  for visual is less than the median  $8 \pm 2.59$  for verbal. The differences of the medians show a critical ratio of 1.53 and while not entirely statistically significant, (by interpolation) there are 93 chances in 100 that this is a true difference.

Figure 11 shows the distribution of 200 visual time scores for Children (Series 1,2,3,4), and 200 verbal time scores for Adults (Series 1,2,3,4). The range of the visual is 0.5 to 35 seconds and for the verbal 0.5 to 300 seconds.



Table XI shows a comparison of all visual scores for

children and adults with all verbal scores for children

and adults. The visual total scores for children is

5,802.00 seconds compared with 1,072.50 for adults. A

greater difference exists in comparing the verbal total

scores of the children, 188,575.00 with the verbal total

scores of adults, 6,785.00. The difference is greater be-

tween children and adults for the verbal method than for the

visual method. Likewise the difference of scores for child-

ren of visual 5,802.00 and verbal 188,575.00 is greater

than the difference of scores for adults of visual 1,072.50

and verbal 6,785.00.

The comparison of the mean of all visual scores of

children and adults, 1.98 to 16.53, the mean of all the

verbal scores of children and adults shows favor to the

visual for both children and adults. The visual scores

have a standard deviation of 4.44 and a standard error of

the mean of .34. The verbal scores show a larger standard

deviation of 27.38 and a standard error of 2.07. The

critical ratio of 5.04 shows statistical reliability in

favor of the visual method.

The median of 4.44 for visual is less than the me-

dian 2.55 for verbal. The differences of the medians

show a critical ratio of 1.03 and while not statistically sig-

nificant (by interpolation) there are 98

chances in 100 that this is a true difference.

Figure 11 shows the distribution of 200 visual time

scores for children (Series 1, 2, 3, 4) and 200 verbal time

scores for adults (Series 1, 2, 3, 4). The range of the visual

is 0.5 to 35 seconds and for the verbal 0.5 to 300 seconds.



Table XI Shows a Comparison of  
200 Visual Scores for Children and Adults  
with  
200 Verbal Scores for Children and Adults

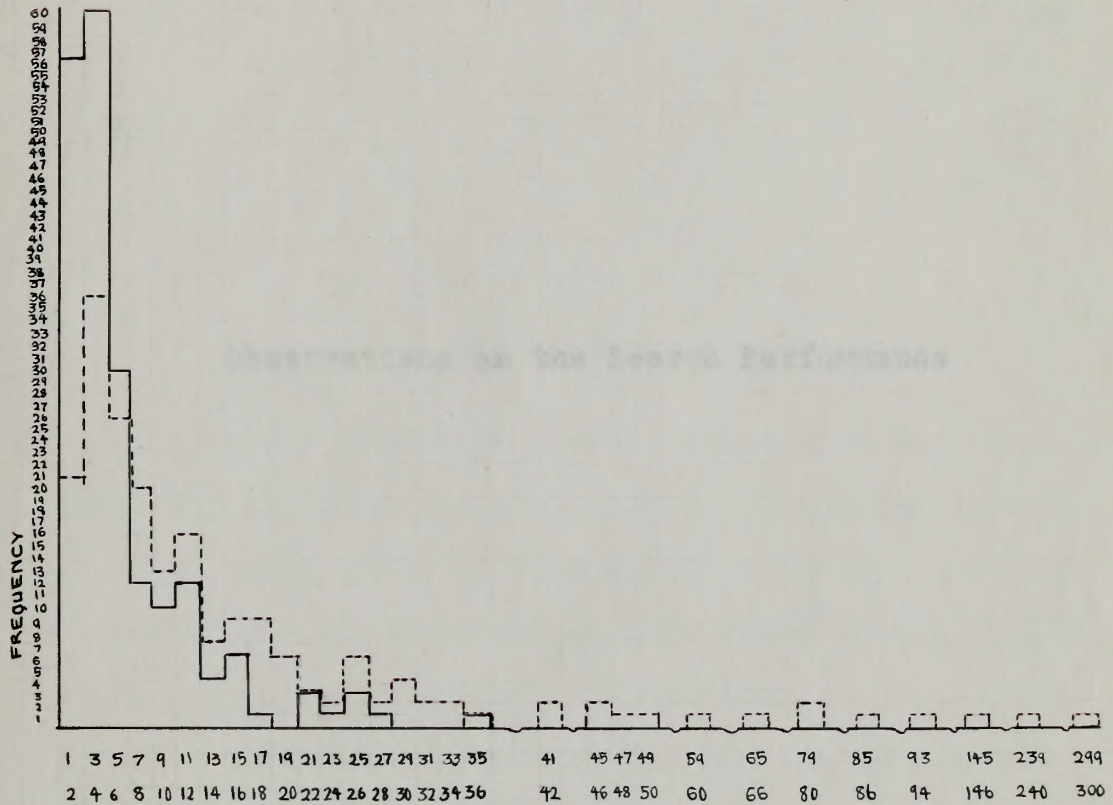
Time Score in Seconds		
	Visual	Verbal
Children	3,802.06	165,579.00
Adults	1,079.25	6,726.00
Total	4,881.31	172,305.00
Median	4.0	8.0
Mean	5.98	16.53
S.D. dis	4.94	29.35
S.E.	.34	2.07
S.E. <sub>m</sub>		
S.E. <sub>mdn</sub>	.43	2.59
Diff. of means		10.55
S.E.		2.10
D.m		
Critical Ratio		5.04
Diff. of medians		4.0
S.E.		2.62
D.mdn		
Critical Ratio		1.53





Figure 11

Distribution of 200 Visual Scores for Children and Adults  
and  
200 Verbal Scores for Children and Adults



Time Scores in Seconds

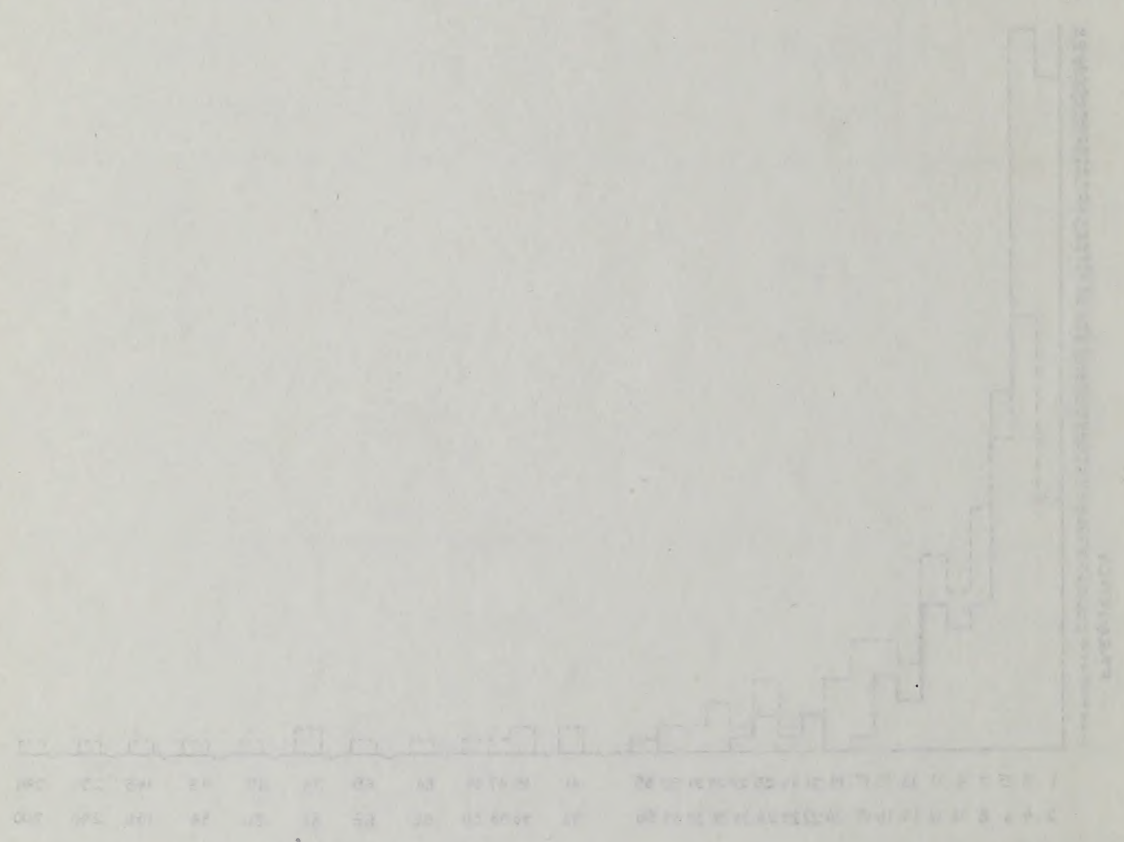
—— VISUAL FREQUENCY BOXES I & II  
- - - VERBAL FREQUENCY BOXES I & II

Figure 11

Distribution of 200 Verbal Scores for Children and Adults

and

200 Verbal Scores for Children and Adults

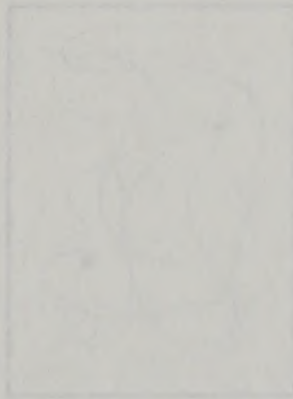


The Score in Seconds

Verbal Frequency Score 100

Verbal Frequency Score 100





### Observations on the Search Performance

The nature of search varied with the individual. Eye patterns revealed that in most cases fixation at first was usually at that point in the scene where the chief interest lay. While engaged in exploring the search field there was usually movement of the eyes.

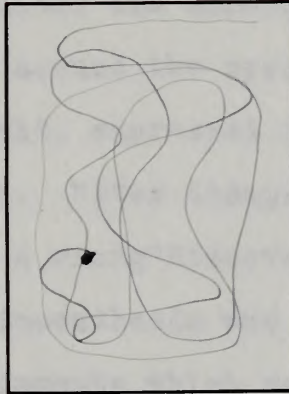
With the visual method of instruction the subjects usually were more systematic in their search. This appears to be true for both children and adults.

With the verbal method of instruction the subjects in the mental picture had to be satisfied by their own interpretation, the eye patterns revealed that

Observations on the Board of Directors



## Observations on the Search Performance



Eye Pattern

The nature of search varied with the individual. Eye patterns revealed that in most cases fixation at first was usually at that point in the Box nearest in view. While engaged in exploring the search field there was saccadic movement of the eyes.

With the visual method of instruction the subjects usually were more systematic in their search. This appears to be true for both children and adults.

With the verbal method of instruction wherein the mental picture had to be established by one's own interpretation, the eye patterns revealed less





systematic search. Age served as an advantage here, due to greater experience and knowledge.

Visual apprehension characterized the search performance for children and adults. The exploring and searching was accompanied by facial contortions (more in children than in adults) and muscular strain, particularly in the forehead and around the eyes. The average person, whether child or adult, expressed an interested intent upon rapid discovery. Utter disappointment characterized the face in case of a wrong "discovery."

Verbal kinaesthesia was demonstrated by pertinent and relevant comments which served to assist toward the goal. There were cases of repeating aloud the name of the object looked for. In the case of hunting for the button there were such remarks as "The Button", "The Button", with bodily movements accompanying the rhythm of speech. Or, pointing to an object and with a voice of interrogation saying, "That is it ? " These gestures and remarks appeared to serve as an aid to discovery.

Touching objects in the field of search was not entirely but almost wholly confined to children. Some children were enticed by some object of their liking in design and color. They delayed their search in order to touch and inspect the object of their choice. There were requests to pursue further the search field after completing the task.



systematic search. The search was an advantage here, due to greater experience and knowledge.

Visual apprehension characterized the search performance for children and adults. The exploring and searching was accompanied by facial expressions (more in children than in adults) and muscular strains, particularly in the forehead and around the eyes. The average person, whether child or adult, expressed an interested interest upon rapid discovery. Utter disappointment characterized the face in case of a wrong "discovery."

Verbal kinesthetic was demonstrated by pointing and relevant comments which served to assist toward the goal. There were cases of repeating aloud the name of the object looked for. In the case of hunting for the button there were such remarks as "The button", "The button", with bodily movements accompanying the rhythm of speech. On pointing to an object and with a voice of interrogation saying, "That is it?" These gestures and remarks appeared to serve as an aid to discovery.

Touching objects in the field of search was not entirely but almost wholly confined to children. Some children were enticed by some object of their liking in design and color. They delayed their search in order to touch and inspect the object of their choice. There were requests to permit further the search field after completing the task.



The process of exploration and discovery was enlivened by feelings of doubt, eagerness, and glorious exultancy upon discovery. Bodily factors were prominently evidenced throughout the entire performance in shifting of the body, head movements, and frequently a finger systematically swept back and forth, up and down to assist in the location of the search object. Eye muscles were fundamental in the shifts of eye pattern. These characteristics were equally applicable to children and adults.

When the search object was indicated by verbal instruction, the children having less advantage than adults due to less experience, demonstrated pause, expectancy, some lack of assurance while the adults carried a feeling of confidence. This accounts for the greater difference in search time for children than for adults, between the visual and the verbal methods of instruction. While a difference in the degree of sustained set existed between children and adults, in both groups the mental and bodily set sustained the search until the goal was reached. Children were less systematic in their search than adults with both visual and verbal instruction. When the goal was reached tension released and relaxation ensued. A feeling of triumph !

In only a few cases did it appear that the element of chance occurred to cause the eyes to fall immediately upon the search object.

The process of exploration and discovery was evidenced by feelings of doubt, hesitancy, and fixation. Bodily factors were prominent in evidenced throughout the entire performance in shifting of the body, head movements, and frequently a finger systematically swept back and forth, up and down to assist in the location of the search object. Eye muscles were fundamental in the shifts of eye pattern. These characteristics were equally applicable to children and adults. When the search object was indicated by verbal

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## Chapter V

## Educational Implications

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## Educational Implications

While this study deals with the developed and functionally complete form of search called "goal search", it is worthy of note that all the functions, namely : perceiving , imagining, remembering, inspecting, comprehending, acting, emotional activity, and elaborative thinking, according to Bentley emerge from a primitive form of search.<sup>1</sup> Perception is the first of these functions to appear. Its importance<sup>2</sup> is expressed in the following statement by Locke. He says, "Perception is the first operation of all our intellectual faculties, and the inlet of all knowledge into our minds."<sup>3</sup>

It has been said,<sup>3</sup> "In the history of experimental psychology no topic has excited more research, and led to more discussion than that of how we perceive, or come to know the positions, relations, and meanings of things around us."

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1. Bentley, Madison, "The Psychologist's Uses of Neurology", The American Journal of Psychology, Vol. XLIX, (April, 1937), p. 236.

2. Locke, John, An Essay on the Human Understanding, Book II, Chapter IX, "Of Perception", p. 96.

3. Garrett, Henry E. Great Experiments, p. 346.





"Sense impressions lie on the basis of all mental activity<sup>1</sup> and have an enormous practical importance in every day life." The higher senses of "hearing" and "seeing" are of concern in this study. It has been the concern of this experiment to investigate these higher senses of "hearing" and "seeing" to detect which might be used to a greater advantage in certain educational procedures.

The first step in economical learning is to establish the goal. If we believe in the principle that responses are selected and organized in terms of their relevance to the learner's goal, then this study has certain definite implications for educational methods. Let us define development of skill, as a series of successive approximations to a successfully completed performance. It is imperative that learners have a clear picture of the successful performance, or a definite knowledge of the appropriate criteria in advance. The right kind of instruction is needed for such successful performance. Just as great care should be taken in selecting tasks for the learner to master, so should we select the type of instruction suitable not only to the situation, but also to the learner. If the child performs his task better, more quickly, and more efficiently by being told what to do, then verbal instruction

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1. Garrett, Henry E. Great Experiments, p.346.





is better for him. If, on the other hand, he performs his task better when shown what to do, then visual instruction should be used for him. In other words, we are attempting to find the best means to an end. While authorities<sup>1</sup> in psychology admit a close relationship between intelligence and problem-solving ability, it should not be assumed that the higher mental processes develop instinctively to the optimum level of functioning. It is said<sup>2</sup> that "training in systematic methods of problem solving is necessary for the attainment of maximum efficiency." Our job now is to give the direction that provides the best aid in problem solving. Our daily life is full of problem solving.

Search is constantly and ever present in problem solving. What is done about search? We can cultivate search by providing the most effective instructions. Shall the instructions be verbal or visual? We instruct through perception. Shall it be verbal or visual perception? We inculcate by example. Shall it be by means of ear or through the eyes?

By carefully controlled experimental procedures this study discovered that visual instruction had significant advantage over verbal instruction for children and adults in the type of performance used; but it further showed that

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1. Gates, Arthur I., Jersild, Arthur T., McConnell, T.R., Challman, Robert C., Educational Psychology, p.332.
  2. Ibid. pp.495-496.





the child profits by visual instruction relatively more than the adult. Should this not have significance in educational methods for children? This evidence of superiority of visual instruction over verbal has already been incorporated into our educational methods in the form of visual aids.

We ask "How much learning employs search?" Do we not search for the purpose of clarifying a concept? Upon rising in the morning the proper garment is searched for. At school, the child searches for his books and pencils. In the library he searches for the proper book. Then he searches the text for answers to his problems. Through the years he makes an observational search of his interests and talents in order to arrive in the profession or vocation of his choice or adaptability. All through life's work we search for truth. As apparently a large part of learning employs search, is it not desirable to learn in the most economical way?

While this study has demonstrated that visual instruction is the more effective way to set a person for an efficient search performance, it is not the purpose of this study to evaluate visual instruction in education. However, it is interesting to note that the educational demonstrations of the value of visual instruction through visual aids is wholly in accord with the findings of this study.

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It has been pointed out , for example, by Knowlton and Tilton's study<sup>1</sup> that "photoplays made a large contribution to the teaching of an enriched course of study, increasing the pupil's learning by about 19 per cent."

An experimental study by Krasker<sup>2</sup> showed that " the educational motion picture proved to be an effective device for increasing factual learning."

## Chapter VI

### Summary

### Conclusions

### Suggestions for Further Research

- 
1. Krasker, Abraham " A Critical Analysis of the Use of Educational Motion Pictures by Two methods." Unpublished Doctor's Dissertation, Boston University, 1940. p.7
  2. Ibid. p.176.

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1. Kravker, Abraham "A Critical Analysis of the Use of Educational Motion Pictures by Two methods." Unpublished Doctor's Dissertation, Boston University, 1940. p. 7

2. Ibid. p. 146.



## **Chapter VI**

### **Summary**

### **Conclusions**

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## Summary

With a group of one hundred Third Grade children of the Belmont Public Schools of Belmont, Massachusetts, and a group of one hundred adults of various vocations, this experimental series of studies designed to discover the "age" and "instruction" differences in the psychological function of search. The experiment was designed to have each subject explore to discover a designated object in a search field. Each subject was given an opportunity to hunt for a designated object in one search field after being shown the object to find. Likewise, he was given an opportunity to hunt for a designated object in another search field by being told what he was to find. Thus, two methods of instruction, "visual" and "verbal" were employed, and a comparison of the search times was made between the two methods. Also, the two age groups (children and adults) were compared as to their search times.

The visual and the verbal methods of instruction fulfilled their purpose in preparing a proper mental set for the search. Data reveal, however, that the visual and the verbal methods stimulated different patterns rather than the same.





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With a group of one hundred Third Grade Children of the Belmont Public Schools of Belmont, Massachusetts, and a group of one hundred adults of various vocations, this experimental study endeavored to discover "age" and "instruction" differences in the psychological function of search. The experiment was designed to have each subject explore 'to discover' a designated object in a search field. Each subject was given an opportunity to hunt for a designated object in one search field after being shown the object he was to find. Likewise, he was given an opportunity to hunt for a designated object in another search field by being told what he was to find. Thus, two methods of instruction, "visual" and "verbal" were employed, and a comparison of the search times was made between the two methods. Also, the two age groups (children and adults) were compared as to their search times.

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The visual and the verbal methods of instruction utilized their purpose in preparing a proper mental set and sustained concentrated attention toward the goal of the search. Data reveal, however, that the visual and the verbal methods demonstrated definite contrast rather



than similarity in degrees of success. The visual method of designating the search-object gives to the individual a feeling of confidence, pleasure, and ease towards success, and a rapid recognition of the object. There is no conflict between the visual image and the perception. The discovery is quick.

The verbal method of instruction calls for an imaginal creation of the object named. A mental concept needs to be established as to size, shape, color, and then it frequently does not match the object sought. That must be discarded and another concept called forth. This conflict throws out the feeling of pleasure, confidence, and ease. The discovery is less rapid.

The statistical data of the study show that the visual method of instruction required less search time for both children and adults :

1. For children, a comparison of search times required by the visual method of instruction with the search times required by the verbal method of instruction shows a visual mean of 7.29 seconds  $\pm$  a standard error of 1.24 seconds and a verbal mean of 24.23 ~~a~~ standard error of 8.12 seconds . The medians were for the visual instruction, 4 seconds  $\pm$  a standard error of 1.55 seconds, and for the verbal, 11 seconds  $\pm$  a standard error of 10.15 seconds.

2. For adults, a comparison of search times required by the visual method of instruction with the search times required by the verbal method of instruction shows a visual mean of 4.50 seconds  $\pm$  a standard error of .66 seconds, and

than similarity in degrees of success. The visual method of designating the search-object gives to the individual a feeling of confidence, pleasure, and ease towards success, and a rapid recognition of the object. There is no conflict between the visual image and the perception. The discovery is quick. The verbal method of instruction calls for an imaginary creation of the object named. A mental concept needs to be established as to size, shape, color, and then it frequently does not match the object sought. That must be discarded and another concept called forth. This conflict throws out the feeling of pleasure, confidence, and ease. The discovery is less rapid.

The statistical data of the study show that the visual method of instruction required less search time for both children and adults:

1. For children, a comparison of search times required by the visual method of instruction with the search times required by the verbal method of instruction shows a visual mean of 7.39 seconds  $\pm$  a standard error of 1.34 seconds and a verbal mean of 24.23 seconds  $\pm$  a standard error of 8.13 seconds. The medians were for the visual instruction, 4 seconds  $\pm$  a standard error of 1.55 seconds, and for the verbal, 11 seconds  $\pm$  a standard error of 10.15 seconds.

2. For adults, a comparison of search times required by the visual method of instruction with the search times required by the verbal method of instruction shows a visual mean of 4.50 seconds  $\pm$  a standard error of .66 seconds, and



a verbal mean of 8.82 seconds  $\pm$  a standard error of 1.64 seconds. Likewise, the median runs lower for the visual, which is 3.75 seconds  $\pm$  a standard error of .83 seconds as compared with the verbal median of 5.5 seconds  $\pm$  a standard error of 2.05 seconds.

In comparing children with adults for the visual method of instruction, the mean for the children is 7.29 seconds. The mean for the adults is only 4.50 seconds. A comparison of children with adults for the verbal method of instruction, shows that the verbal mean of 8.82 for adults is smaller than the verbal mean of 24.23 for children. The data reveal that a greater difference in search times exists for children between visual and verbal methods of instruction than exists between the two methods for adults.

When comparing all visual scores for both children and adults with all verbal scores for both children and adults, the data show that the visual mean is 5.98 as compared with the verbal mean of 16.53, and likewise, the visual median is 4 as compared with the verbal median of 8. Of the two methods of instruction, "visual" and "verbal", the visual method of instruction is superior to the verbal method of instruction as judged by the time required to complete successfully the search.





## Conclusions

The results of this experimental study suggest the following conclusions :

1. For children, a comparison of search times required by the visual method of instruction with the search times required by the verbal method of instruction showed that the visual method proved to be more advantageous in that it required appreciably less time than the verbal.

## Conclusions

2. For adults, a comparison of search times required by the visual method of instruction with the search times required by the verbal method of instruction showed that the visual method proved to be more advantageous in that it required appreciably less time than the verbal.

3. When comparing children and adults, the greater difference in search times between the visual and the verbal methods of instruction was found among children.

4. A comparison of the visual and the verbal methods of instruction for variability in search times revealed the greater variability in the verbal method. A comparison of variability of search times between children and adults revealed greater variability for children.





### Conclusions

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2. For adults, a comparison of search times required by the visual method of instruction with the search times required by the verbal method of instruction showed that the visual method proved to be more advantageous in that it required appreciably less time than the verbal.
3. When comparing children and adults, the greater difference in search times between the visual and the verbal methods of instruction was found among children.
4. A comparison of the visual and the verbal methods of instruction for variability in search times revealed the greater variability in the verbal method. A comparison of variabilities of search times between children and adults revealed greater variability for children.

## Conclusions

The results of this experimental study suggest the

following conclusions :

1. For children, a comparison of search times required by the visual method of instruction with the search times required by the verbal method of instruction showed that the visual method proved to be more advantageous in that it required appreciably less time than the verbal.
2. For adults, a comparison of search times required by the visual method of instruction with the search times required by the verbal method of instruction showed that the visual method proved to be more advantageous in that it required appreciably less time than the verbal.
3. When comparing children and adults, the greater difference in search times between the visual and the verbal methods of instruction was found among children.
4. A comparison of the visual and the verbal methods of instruction for variability in search times revealed the greater variability in the verbal method. A comparison of variabilities of search times between children and adults revealed greater variability for children.



5. Adults showed a superior advantage over children in the ability to form and to maintain an adequate set for search and discovery.

6. There was detectable difference between children and adults with respect to the manner in which the searching process is carried out. Touching of objects and verbal kinaesthesia were more pronounced in children than in adults. Bodily and mental poses were less in evidence among adults than among children. Adults were more systematic in search than were children.

7. The data from this experimental study reveal that the visual method of instruction proved superior to the verbal method of instruction for both children and adults .

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7. The data from this experimental study reveal that the visual method of instruction proved superior to the verbal method of instruction for both children and adults.



This experimental study has suggested the following topics for further research :

1. Sex Differences. If the data of this study were analysed for sex differences, would differences be found between the two sexes ?

2. Intelligence. Would children with high and low intelligence quotients differ in characteristic ways in carrying out a search task ? Would intelligence be a factor in determining the relative effectiveness of the visual and the verbal modes of instruction ?

### **Suggestions for Further Research**

3. Age Norms. A more precise location of differences in search for the various age levels.





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3. Age factors. A more precise location of differences in search for the various age levels.



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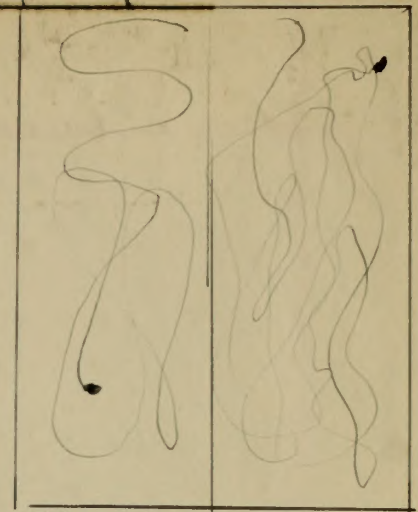
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Series \_\_\_\_\_ Group \_\_\_\_\_  
 Date of Test \_\_\_\_\_  
 Name of Child \_\_\_\_\_  
 Age \_\_\_\_\_ years \_\_\_\_\_ months \_\_\_\_\_  
 Birthday \_\_\_\_\_  
 Sex \_\_\_\_\_ Race \_\_\_\_\_  
 Grade \_\_\_\_\_  
 I. Q. \_\_\_\_\_ M. A. \_\_\_\_\_



Box I  
Visual  
instruction

Box II  
Verbal  
instruction

Time for Test \_\_\_\_\_

Method of Attack

approach (systematic or lack of system) \_\_\_\_\_  
 eye movements \_\_\_\_\_  
 facial expression \_\_\_\_\_  
 posture \_\_\_\_\_  
 bodily movements \_\_\_\_\_

Disposition-----Attitude \_\_\_\_\_  
 maintaining problem \_\_\_\_\_

Child's remarks \_\_\_\_\_  
 concept of search object (for auditory) \_\_\_\_\_

Miscellaneous \_\_\_\_\_

Urging or prompting \_\_\_\_\_

Date of Test

Name of Child

Age \_\_\_\_\_ years \_\_\_\_\_ months

Birthdate

Sex \_\_\_\_\_ Race \_\_\_\_\_

Grade

I. Q. \_\_\_\_\_

Time for Test

Method of Attack

Approximate (systematic or lack of system)

Eye movements

Facial expression

Posture

Body movements

Diagnosis—Attitude  
maintaining position

Child's Remarks  
Summary of results of test (for history)

Miscellaneous

Opinion or suggestion

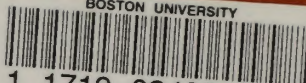


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